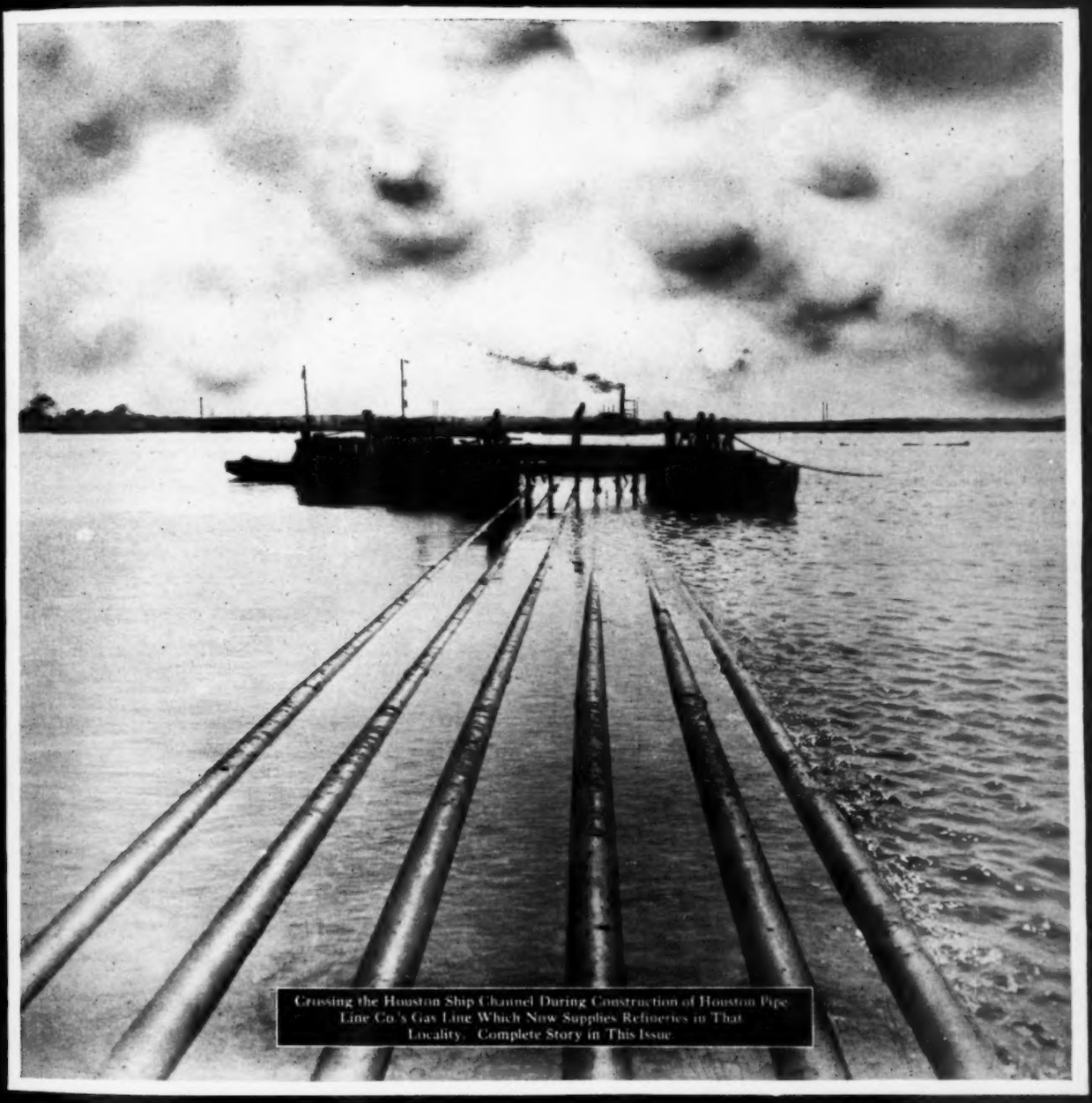

Crossing the Houston Ship Channel During Construction of Houston Pipe Line Co.'s Gas Line Which Now Supplies Refineries in That Locality. Complete Story in This Issue

Amongst those who have taken license under the patents covering the Processes of Contact Filtration are:

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Standard Oil Company of New Jersey
Standard Oil Company (Indiana)
The Texas Company
Vacuum Oil Company

Aside from their economy the Processes of Contact Filtration are responsible for the production of oils of a character which it would seem cannot be manufactured in any other way.

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Petroleum Engineer

The Engineering Magazine of the Oil and Gas Industry

Volume 1 APRIL, 1930 Number 7

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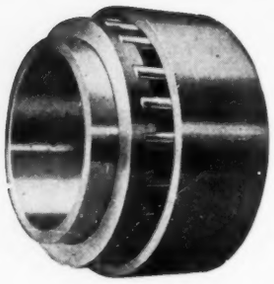

MANUFACTURERS *have to keep stepping*

to keep up with

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CHANGING conditions, changing ideas, changing data — the whole industry has been making change after change in order to meet more exacting requirements—and to meet them better than any requirements—old or new—have been met heretofore.

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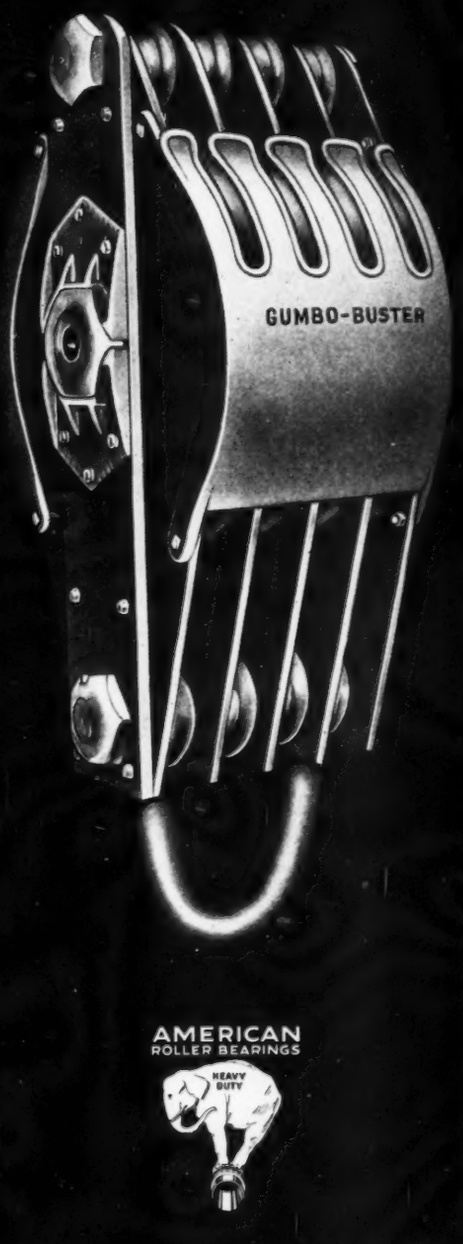

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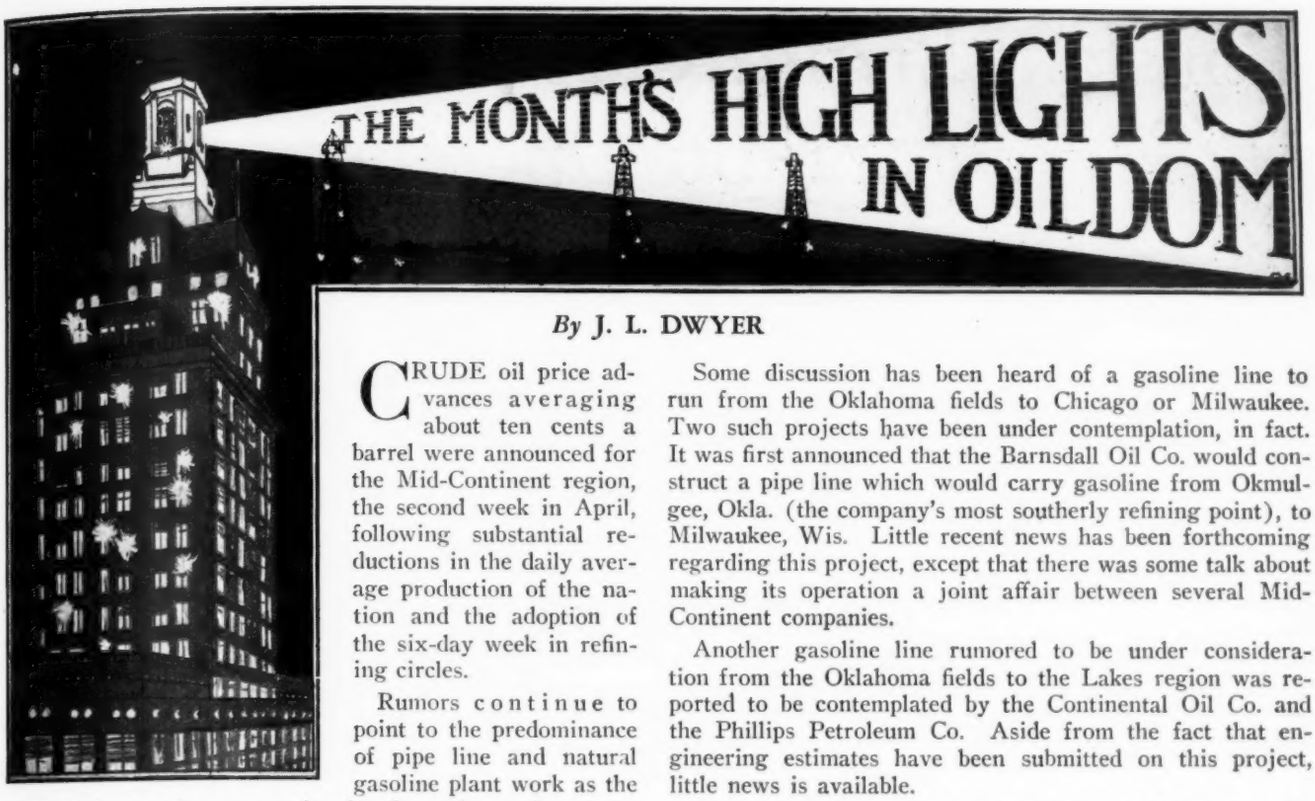


By J. L. DWYER

GRUDE oil price advances averaging about ten cents a barrel were announced for the Mid-Continent region, the second week in April, following substantial reductions in the daily average production of the nation and the adoption of the six-day week in refining circles.

Rumors continue to point to the predominance of pipe line and natural gasoline plant work as the major influences in construction for the spring and summer. Natural gas, with its ever-growing expansion policy, will also play an important part in summer activities.

The growing importance of the Hobbs area of New Mexico seems to indicate that the Atlantic Oil Producing Co., the Shell Pipe Line Co., and the Humble Oil & Refining Co. may construct pipe line systems from the oil storage districts of West Texas to this region of New Mexico. In this connection it is reported that the Texas-Pacific Coal & Oil Co. has been figuring on building a pipe line from its production in Lea County, New Mexico, to a point in Winkler County, Texas.

In the region extending from the Mid-Continent to the Great Lakes, it appears that the Texas-Empire Pipe Line Co. will add ten new pump stations to its line which runs from Drumright, Okla., to Chicago. This line is now in full operation, after some preliminary difficulties. The line, when run to the new capacity, will help supply the additional demand which the Lakes region has steadily been making upon the Mid-Continent territory.

Some discussion has been heard of a gasoline line to run from the Oklahoma fields to Chicago or Milwaukee. Two such projects have been under contemplation, in fact. It was first announced that the Barnsdall Oil Co. would construct a pipe line which would carry gasoline from Okmulgee, Okla. (the company's most southerly refining point), to Milwaukee, Wis. Little recent news has been forthcoming regarding this project, except that there was some talk about making its operation a joint affair between several Mid-Continent companies.

Another gasoline line rumored to be under consideration from the Oklahoma fields to the Lakes region was reported to be contemplated by the Continental Oil Co. and the Phillips Petroleum Co. Aside from the fact that engineering estimates have been submitted on this project, little news is available.

In the announcement that the Missouri Valley Gas Co. will build a natural gas system to transport gas from the Stevens County, Kansas, fields to Eastern Nebraska and into Iowa, another important gas project takes form. The Missouri Valley Gas Co. is a Moody-Seagraves subsidiary. The construction of such a gas system will mean the expenditure of about $12,000,000.

It seems extremely likely that next Christmas will witness natural gas being burned in the city of Chicago. During the past month the plans for the construction of this project have crystallized, and among the names which are mentioned in this connection are the Cities Service Gas Co., The Texas Company, the Skelly Oil Co. and the Insull Interests of Chicago. Coincidental with the reports of activity in the construction of this line there was a marked increase in leasing activity along the territory which marks the line between the Texas Panhandle fields, with their gas reserves, and Chicago. Such a line would cross the northwestern corner of Oklahoma and the state of Kansas in the general region of Stevens County.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending March 29, 1930
(Figures in Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	3,120,800	73.6	9,550,000	6,314,000
Appalachian	91.0	643,900	78.9	1,865,000	668,000
Ind., Ill., Ky.	99.5	2,295,100	87.9	8,479,000	3,056,000
Okla., Kan., Mo.	89.1	2,195,200	76.2	4,700,000	3,622,000
Texas	90.4	3,901,500	78.2	8,153,000	11,072,000
Louisiana - Arkansas	96.8	1,141,200	62.2	2,553,000	2,008,000
Rocky Mountain	93.6	384,500	39.4	3,049,000	1,059,000
California	99.3	3,753,300	60.2	16,390,000	108,387,000
Total Wk. Mar. 29	95.6	17,435,500	70.9	54,739,000	136,186,000
Total Wk. Mar. 22	95.5	17,744,400	72.5	53,830,000	137,253,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts:					
Texas Gulf Coast	99.4	2,963,900	80.9	7,076,000	8,490,000
Louisiana Gulf Cst.	100.0	751,700	72.8	2,207,000	1,174,000

Daily Average Production
(Figures in Barrels)

	Mar. 29 1930	Feb. 22 1930	Mar. 30 1929
Oklahoma	615,000	646,800	644,350
Kansas	114,500	110,600	94,150
Panhandle Texas	89,900	89,000	60,700
North Texas	80,450	81,000	83,800
West Central Texas	51,150	53,050	52,350
West Texas	322,000	340,700	378,850
East Central Texas	25,400	23,600	19,900
Southwest Texas	61,000	66,750	72,200
North Louisiana	43,300	41,700	35,700
Arkansas	58,600	58,150	74,250
Coastal Texas	193,650	175,000	126,600
Coastal Louisiana	20,500	22,950	21,550
Eastern (not including Michigan)	120,000	120,400	104,950
Michigan	11,750	13,800	4,800
Wyoming	50,850	49,200	51,400
Montana	9,300	8,250	10,200
Colorado	4,750	4,850	6,750
New Mexico	11,000	10,250	2,850
California	631,100	806,000	781,900
Total	2,514,200	2,722,050	2,627,250

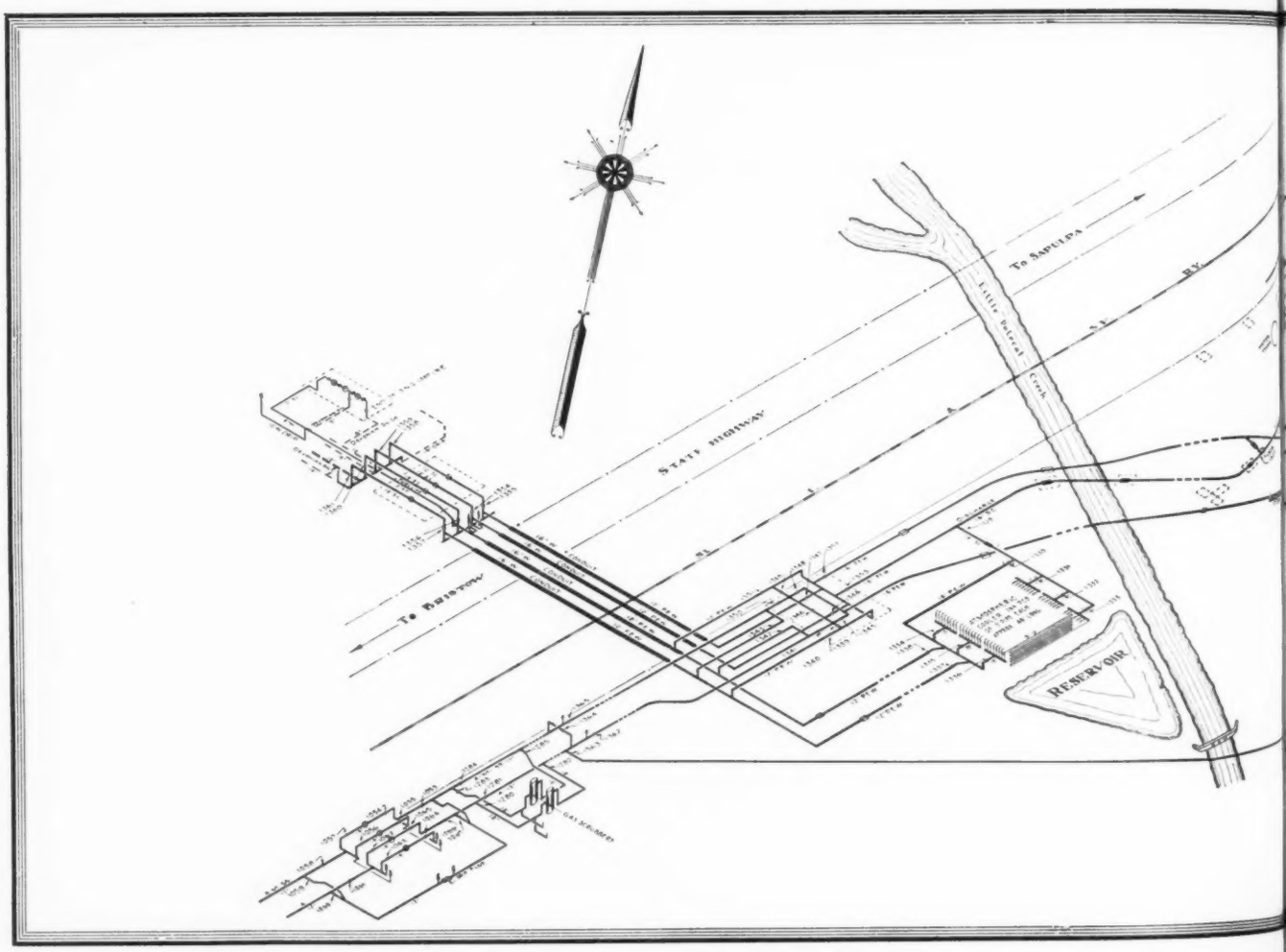
Constant Engine Care *is* Major Factor *in* Station Operation

By J. H. DAMERON

ONE of the oldest and smoothest-running gas pumping stations in the Mid-Continent, and one which incorporates modern design in piping layout, is the Oklahoma Natural Gas Corp.'s Kellyville compressor station at Kellyville, Creek County, Okla. With the piping layout at the plant the operators can do virtually anything with the gas streams that is desired at a station. The station was built in 1911 and since that time the care the crew gives the engines is reflected in the record of not having a single forced shutdown or a burned-out bearing during the 18 years of operation. It is powered with four 650 horse-power engines that can handle around 60,000,000 feet of gas daily when operated to capacity. Close inspection and check of the units is attributed as the reason for their remarkable performance. When in operation the units are usually run at a speed of 90 r. p. m. The average pressure on the suction lines is around 150 pounds and the discharge pressure is usually around 300 pounds.

E. E. Regan, Chief Engineer, Kellyville Station

The operating crew for the most part consists of veterans at Kellyville who are familiar with the operating characteristics of the engines. Despite their age, all four of the units operate smoothly and because of the care given them, along with good foundations, the units do not vibrate. Lubrication of the units is carefully watched and the oil is run continuously through a filter. The oil flows by gravity from an overhead tank in one end of the building and is picked up from the sump and delivered to the filter where another pump moves it to the overhead tank. Each year during the summer months each unit is overhauled, the valves ground, ignition system checked, bearings tightened, rings inspected and in general a complete check-up of the unit is made to make sure the water and fuel systems are also in good condition. Particular attention is given to the tightning of the bearings to make certain this work is completed properly. Regulation of fuel to the big engines and the auxiliary engines is controlled by the gasometers located in the same building with the regulators and meters. Two cuts are made before the fuel gas goes through the meter and into the fuel header. However, when only the auxiliary engines are operating the steam is diverted from the hook-up of big regulators and



one cut is made before the fuel goes to the recording meter.

In another part of the same building are the steam and air pumps used to handle the lubricating oil. Both pumps are 3 by 2 by 3 and one pumps from the sump to the reclaimer and the other discharges the clean oil into the overhead tank. Both pumps are so connected that in the event of trouble on one pump the other can be used to pick up the dirty oil and then by valve arrangement be used to deliver the clean oil to the overhead tank. Both pumps can be operated with either steam or air. In the winter months when the heating plant is in operation steam is used and during the summer months they are operated by air from the air storage tanks. As a safety measure a two-inch drain line from the overhead tank to the ground storage has been installed. In case of fire in the station the tank may be emptied quickly.

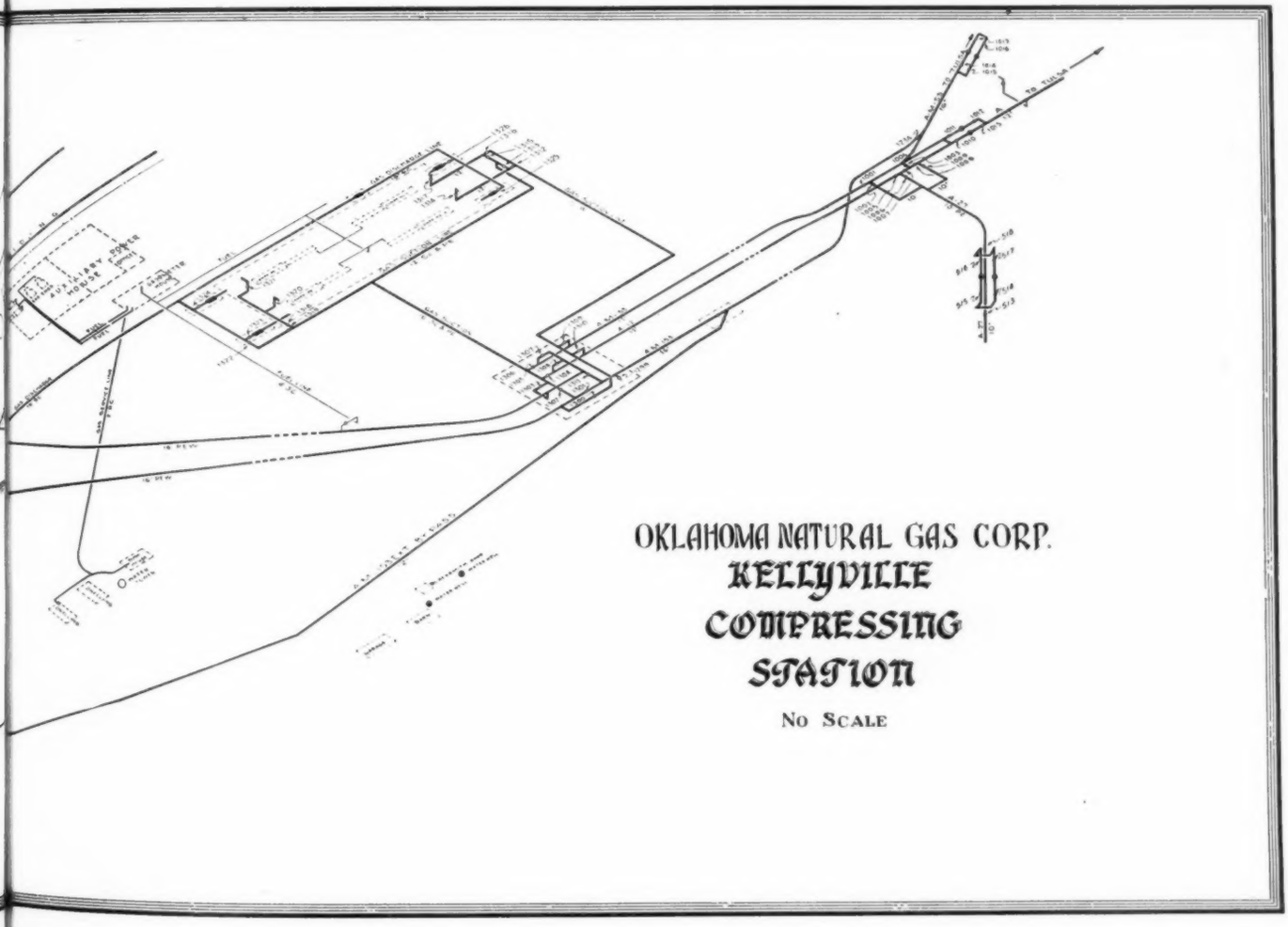
Air storage chambers at Kellyville.

Ordinary station operation is to pump from the west to the east with a gasoline plant running as much of the gas as desired through the plant near the compressor station. However, gas may be pumped either direction or by-passed around the station. A 12-inch by-pass was built around the station recently and may be used to by-pass the station in the event of trouble or at any time desired.

Gas coming in from the west is measured at the junction about a mile west of the station and goes through the scrubbers before going on to the station's suction lines. After leaving the compressors the gas passes through five expansion joints on its way to the cooling coils and then to the station manifold. The two lines coming in from the west are 12-inch and two of the three discharge lines going east are 12-inch and the other is 16-inch. After leaving the next junction there are only two discharge lines, one 16-inch and one 12-inch going on east.

The two 50 horse-power, 180 R. P. M. gas engines in the auxiliary house are connected with a belt to a line shaft from which the air compressors, water pumps and generators are driven. The line shaft and pulleys are located against a wall of the building and are housed in as a safety measure. The 15 K. W., 125-volt, 675 R. P. M., 120-amp. generators are set up between the gas engines and the line shaft and the belt connecting them to the shaft is enclosed in a steel screen.

Both of the water pumps, which discharge the water into the overhead tank, are located in the cellar of the building and are driven from the main line shaft. All of the water is pumped from a nearby stream and the water from the hot wells drains back into the stream at a point lower down. Before the drainage water goes back into the stream it goes through a skimming vat where all of the waste oil from the engines is caught and skimmed off.



The heating plant is located in the same building with the auxiliary equipment, but separated with a fire wall. The two boilers generate steam heat for the station and its immediate buildings and operate the hot-water system for the locker rooms. Steam coils located along the walls of the building are used as radiators.

T. L. Padden, superintendent of compressor stations, was with the company's construction department when the plant was built and was the chief engineer of the station when it was placed in service. E. E. Regan, present chief engineer, was a member of the crew when Kellyville station was started. The stations are constructed with brick and steel. The craneway is supported by the walls and the sheet metal roof is braced with angle irons. To give additional light a skylight was built in the roof. All of the fixtures in the building are vapor-proof.

The floors are kept religiously clean and the glossy coat of gray paint aids in keeping the floor tidy. The walls are also painted, but with a lighter coat of paint to improve the lighting conditions. The engines are also painted to improve their appearance and are free from oil leaks.

The same type of construction used in the main station was used to build the auxiliary building and gasometer. house. All of the cottages and garages are frame buildings and located in the most shaded section of the station site. Water supply for the dwellings comes from shallow water wells located on that part of the site.

All manifolds and most exterior equipment are painted a light color to reflect the sun's rays as much as possible during the summer months. Air tanks have been built with 16-inch pipe with a view toward providing ample air storage. The main storage consists of 160 feet of 16-inch pipe with welded ends. The storage is strapped on concrete anchors. The line going to the engine room is comprised of 100 feet of 12-inch pipe.

Ordinarily a pressure of 165 pounds is maintained in the air tanks. Each tube or tank can be blown out through a blow-off valve to clean the tank. A whistle is located near the tanks and is used as a warning to the gasoline plant operators whenever an additional unit is to be started at the compressor station. The gate valve pits are well drained and the fittings painted. To add to the attractiveness of the manifolds the flanges are painted a different color from the general color used to paint the valve and pipe.

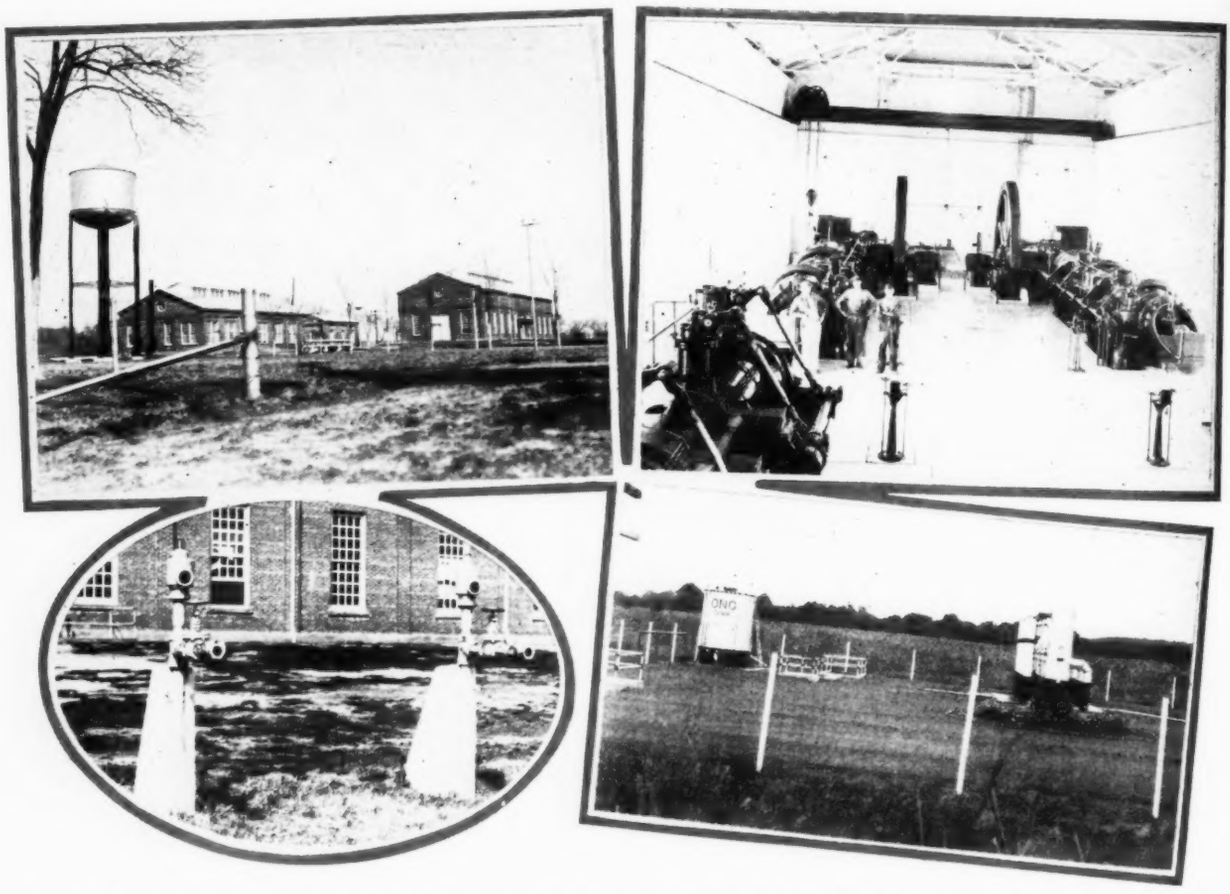
A fence made from salvage pipe encloses the station grounds, which has been sodded and the grass kept cut close. The crew takes a great pride in the grounds during the summer months when all of the flowers and plants are blooming and add to the attractiveness of the site.

Safety records are constantly being established at Kellyville and various measures are taken to insure safety to employes and the equipment. Guard rails and screens surround all of the moving parts and tripping hazards in the buildings have been removed. Placards, designed to attract attention, warn against fire dangers and other hazards.

One of the several operating safety measures is the installation of pop valves on the discharge lines to insure prevention of pumping against a closed gate. These valves are located over each discharge line near the main manifold. They are set to pop at a pressure of 325 pounds and as they do so, they make a shrill noise easily heard in the station.

The speed with which the units at Kellyville can be started is somewhat of a record. Under ordinary conditions around 20 minutes is consumed in starting all four of the engines. However, in emergencies when a sudden pull is put on the line, much better starting time is made. The record of the station was made one evening when three units were started in eight minutes flat. While one unit was being started another unit was being made ready and in this manner the record was established.

The operation program instills a pride in the station crew that reflects itself in low maintenance and operation costs.



Upper left, general view of Kellyville station; right, interior of the station; lower left, safety valves; right, scrubbers on the intake line.

Fast Time Made With Houston Gas Line River Crossing

WITH only 12 hours allotted to put six 10-inch lines across a 2,900-foot water crossing in the Houston ship channel on the Gulf Coast, and most of them during darkness, the Macpherson Construction Co., contractors on a 24-inch gas line built for the Houston Pipe Line Co., accomplished the job with time to spare by using methods not commonly used in making river crossings.

Approximately six weeks were required to dredge out the trench and build the crossing on the shores. When finished, the trench in the channel was seven feet deep and 100 feet wide on the bottom. The top of the trench was approximately 150 feet wide. Much time was consumed in dredging because the dredges were forced to move frequently to permit boats to pass.

Completing final details prior to putting a river crossing into the channel.

Detail of construction of a manifold for river crossing.

Lines strapped together ready to be shoved across channel, and barges and dredges being moved.

The crossing was built on both shores. It was welded on rollers to permit construction of straighter sections and make it easier to move into the water. After testing the line at around 900 pounds, everything was made in readiness for the crossing.

Clearing away equipment preparatory to completing crossing.

Navigation officials allotted 12 hours to the pipe line company to put in the crossing. During that time the contractors would not be interrupted by boats. A windstorm caused the attempt to be delayed the first night.

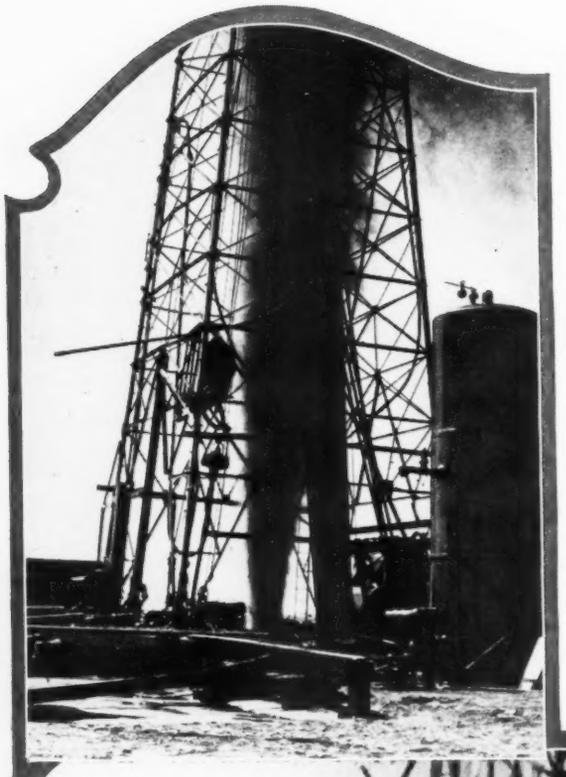
On each shore wooden towers were built and flares located in the center. Prior to starting across with the lines, iron straps were put on to keep the lines from crawling over each other and to make it easier to handle them. River clamps were put on as the line was moved across.

Several barges and tugs were on the scene to aid in the work. The lines were lashed between two tugs and the first two were piloted by a tug, while other tugs kept them on a true course. Pairs of barges were used to hold up the pipe about every 300 feet. On each set of barges a flare was located.

Men on opposite shores could instantly see by looking across to the row of flares which set of barges was out of line. These men were equipped with flashlights and signaled to the tugs with them. In this manner the barges were kept on a true course and the lines were lowered in the trench without a mishap.

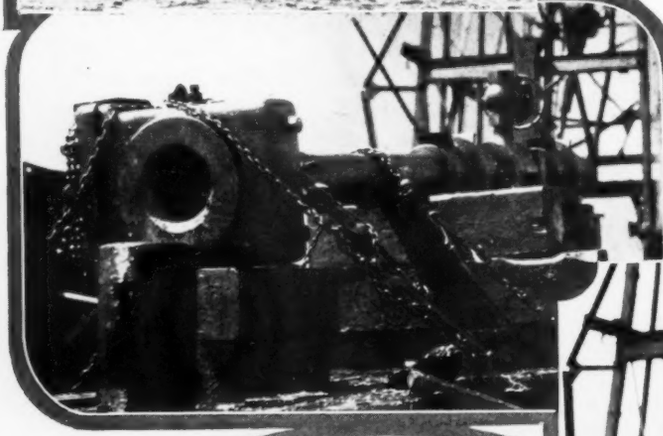
Promptly at 7:00 p. m. on the evening the job of crossing the channel was to start, crews started moving the two sections across from opposite shores to get the advantage of as much daylight as possible. Winch lines were extended back shore and attached to the pipe. When tractors attached to the winch lines started pulling, the lines were shoved toward midstream. By close spacing of the barges and having the lines suspended the crossing was completed in the allotted time.

"WILD WELL" *in the* Oklahoma » » » CONTROLLED *After*



WEDNESDAY morning, March 26, 1930, at 6:45 o'clock, the Indian Territory Illuminating Oil Company's well, Mary Sudik No. 1, in the Oklahoma City Field, "blew in" unexpectedly, and ran wild for about eleven days before it finally was brought under control on Sunday evening, April 6. It proved to be one of the most stubborn gushers to resist control by man-made devices in the whole history of the Mid-Continent oil fields. Twice during the 11-day period was the well subdued only to kick over the traces again after a few hours and continue its deafening roar of defiance. Only by the dogged, unrelenting efforts of the field force and officials of the Indian Territory Illuminating Oil Company was the rampant career of the well cut short. How it was brought safely under control and the valiant, unflagging, painstaking labor of the crew of about 14 men under the direction of W. P. Sutton and C. O. De Verse, division and asst. division superintendents, respectively, of the I. T. I. O. Co., form an interesting chapter in the annals of oil field development.

An enormous rock pressure, estimated at 2,300 pounds per square inch, combined with a voluminous open flow variously estimated at 1,500 to 2,000 barrels of oil an hour and well in excess of 100 million cubic feet of gas daily, indicate the extremely hazardous conditions which were faced. The well came in as a gasser, but after 30 hours, about noon Monday, March 27, the well started spraying oil. With the oil came fine sand which was highly abrasive under the high fluid velocities at the well head. The total depth of the well is 6,471 feet. Two long strings of casing in the well consist of 5,428 feet of 9-inch cemented with



Top to bottom—The well running wild; the overshot nipple first used in an attempt to shut in the well; the swage nipple which was sand cut. Lower right, working around the well while it was going full blast.

City Field SUCCESSFULLY Stubborn Resistance « « «

1,500 sacks of cement, and 6,396 feet of 7-inch cemented with 250 sacks of cement. The 7-inch casing is hung on slips in a casing packing head on the 9-inch casing, which effectively packs off the annular space between the 9-inch and 7-inch casing. The exact status of casinghead connections, surface and derrick equipment, were carefully ascertained in making preparations to harness the well. It was found that the top of the 7-inch casing—the threaded end without a collar—which was about two or three feet below the derrick floor, was in good condition and protruded above the packing head on the 9-inch casing about 14 inches.

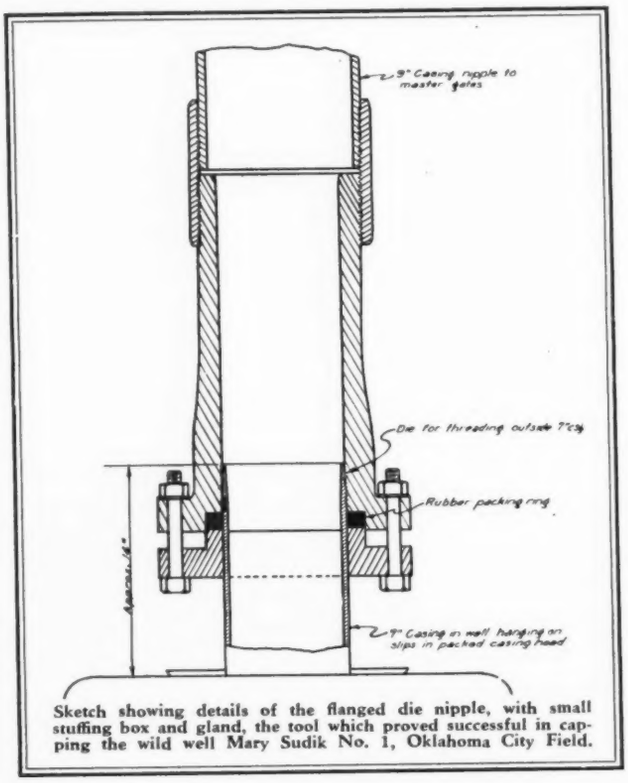
In the first attempt to cap the well, a special coupling to screw on to the 7-inch casing was made up and provided with an ingenious arrangement of vertical fan-tailed blades or vanes (see illustration), which would act as a guide and aid materially in steadying the connections while lowering on to the well casing. A special extra heavy 7 by 9-inch swaged nipple was screwed into the special coupling and above, two master gates and other Christmas-tree connections, surmounted by a joint of 9-inch casing. Lugs for snubbing and guy lines were welded on couplings at the upper and lower end of the string of connections above and below the master gates. After some hours' work, during which it was found that whipping of the pipe was more troublesome than the need for snubbing, the well was first shut in at 8:15 p. m., Sunday, March 30. A slight coupling leak next to the swage nipple allowed the fluid to sand blast its way completely through the pipe in a short time, with the result that by 3:00 p. m., Monday, March 31, the well again was completely out of control.

Top to bottom—Cutting off a joint of casing after the well was shut in; the pumps used to keep the derrick cellar clear of oil; the crew wearing steel helmets and goggles prepare some fittings. Lower left, special coupling equipped with fan-tail blades which steadied the connection while it was lowered over the casing.

A casing over-shot type of gate with hard steel encased rubber rams (see illustration) was next used, as it was feared the threads on the 7-inch casing were badly damaged. By 6:15 p.m., Friday, April 4, the well was once more brought under control. Eddying of the fine sand-laden fluid on the upper side of the casing over-shot valve caused so serious a leak at 10:30 p. m. that the well was opened up wide again at 11:15 p. m. after being under control for five hours.

Meanwhile the field and engineering staffs of the I. T. I. O. Co. were lending every effort to devising equipment and to following up with other methods in case of failure. Homer Craig, a veteran at handling large, unruly wells in Mexico, made a hurried trip by airplane from Tampico, Mexico, to lend his aid.

A die nipple with a stuffing box and gland on bottom (as shown on the accompanying sketch) was made specially for screwing on to the 7-inch casing. This was made available about 4 o'clock Sunday afternoon, April 6. By 7:10 the same evening the casing control connections were securely in place and by about 10 p. m. the well was completely closed in. To guide the die nipple into place on the casing, a split guide with fantail blades or vanes, similar to the guide used on the first attempt and illustrated in the accompanying photographs, was attached by the gland bolts until the die nipple was safely over the 7-inch casing, after which it was removed. About two and a half inches of new thread was cut on the 7-inch casing. The stuffing box with one ring of square rubber packing was used to insure against the possibility of leakage between the new thread on casing and the die nipple. The Christmas-tree connections were securely anchored. After 72 hours in place without any sign of leakage, apprehension as to the success of the job has gradually disappeared.

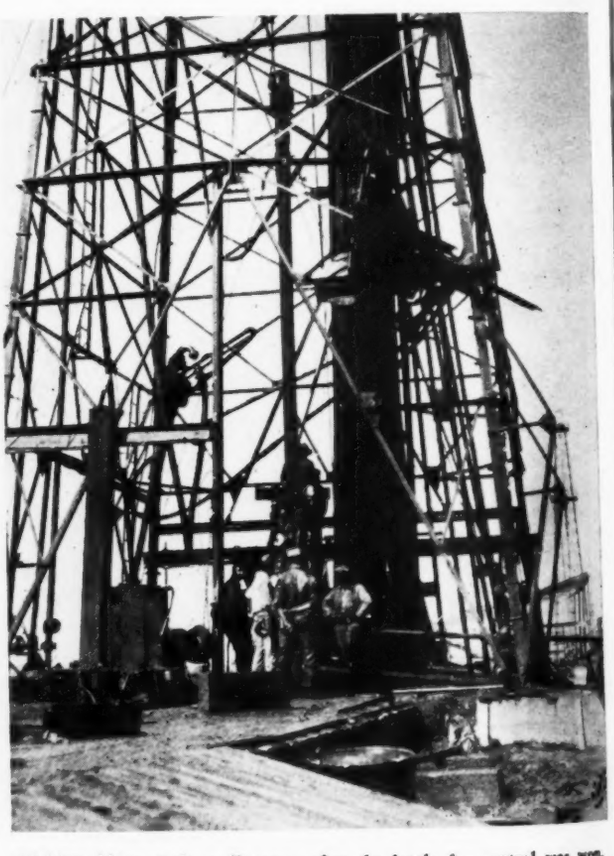

9" Casing nipple to master gates
Die for threading outside 7" Csg
Rubber packing ring
Approx. 18"
9" Casing in well hanging on slips in packed casing head

Sketch showing details of the flanged die nipple, with small stuffing box and gland, the tool which proved successful in capping the wild well Mary Sudik No. 1, Oklahoma City Field.

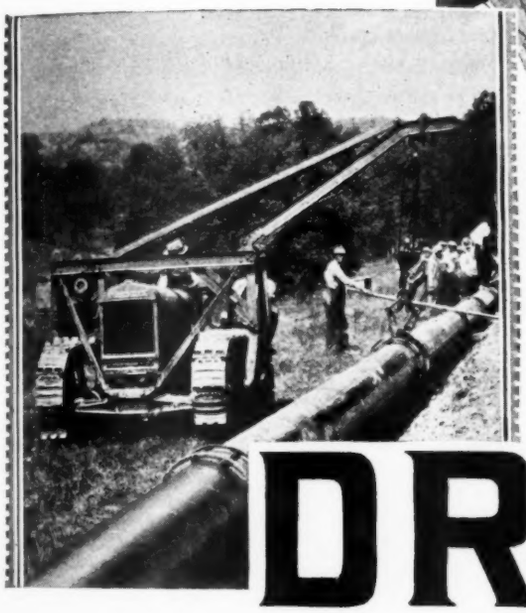
Throughout the trouble the same crew of about 14 men stayed on the job and fought it to a successful conclusion. Much credit is due the operators, fire marshals and other Oklahoma City officials, who co-operated so effectively with the I. T. I. O. Co. officials and lent their aid in the strict observance of fire safety rules, thus assisting greatly in removing the ever-present menace of fire.

Additional photographs of this well appear in the Pictorial Petroleum section.

A close-up looking into the cellar of the "wild" well. Note the pump suction lines into cellar to prevent flooding with oil.



Making things at the well secure after the battle for control was won.



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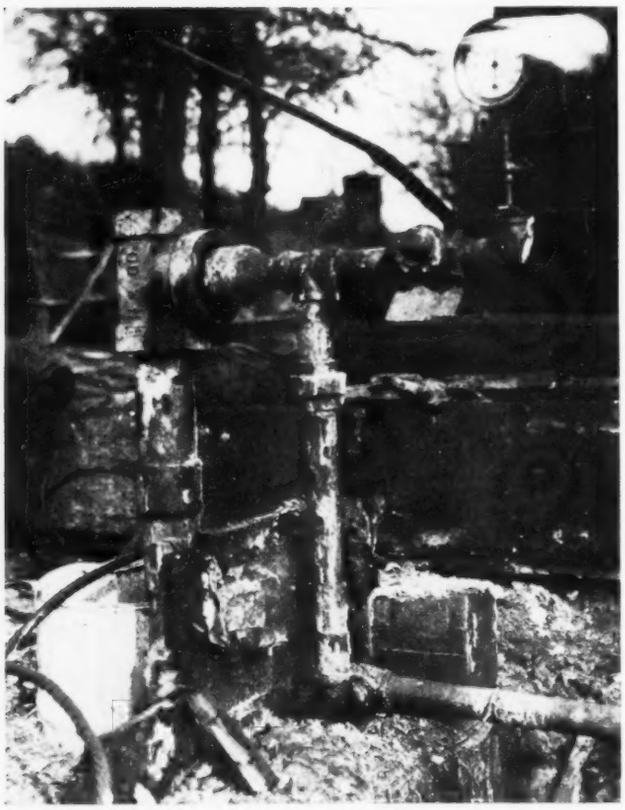


A well of the Peters Petroleum Company into which a volume of 1000 barrels of salt water daily has been pumped for about a year.

Economical Method of Salt Water *On Small*

« « «

THERE are many small wells in Oklahoma, rightly considered in the class of settled production, which make large quantities of salt water along with the oil. Average water-oil ratios range from two to eleven barrels water per barrel of oil. Apart from the added oil lifting and treating costs which generally are involved in high water-oil ratios, the problem of disposal of the salt water becomes a source of worry and expense to the operator. Many small producing leases in Oklahoma are in the midst of farm lands. Long droughts add to the difficulties of the producer because trouble arising from pollution of surface waters and streams calls for incessant care unless adequate provision is made for getting rid of the water in a manner that will not conflict with existing regulations. So important has the problem of salt water disposal become that when a new field is discovered operators usually get together and discuss ways and means concerning the best and most economical method of handling the salt water situation if and when it develops, and begin making provisions accordingly.

In this connection, in Texas it is now becoming common practice to form a separate company to handle the salt water disposal in a field where large quantities of salt water are anticipated. In a project of this kind the planning is done on a strictly engineering basis. Charges usually are allocated on a per well basis, which arrangement, it is claimed, generally works out to be the most equitable to all concerned, avoids confusion and reduces the amount of accounting and expense that would be incurred were charges prorated on a strictly barrelage basis.

In small, isolated pools, where the daily rate of production per well is relatively small and the water-oil ratio relatively high, the small independent producer is obliged to provide his own facilities for disposing of the salt water produced by his wells. Several methods are in successful use, any one of which can probably be adopted to suit the particular requirements.

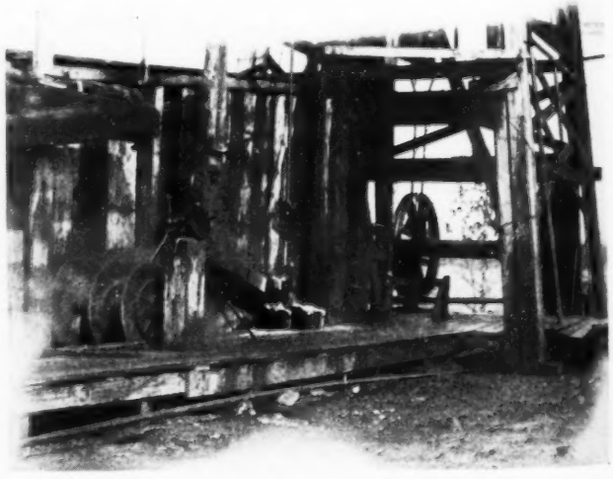
Where the rate of natural evaporation exceeds the amount of rainfall, and where the pollution of surface waters is not a problem, the evaporation method is adaptable. This method is in successful use at Cisco, Wichita Falls and West Texas. In the Wichita Falls, Cisco and San Antonio areas of Texas the evaporation is such that approximately 800 square feet of surface is required to evaporate one barrel of salt water a day throughout the year. In West Texas, because of the greater rate of evaporation, only about 650 square feet is required to evaporate one barrel of salt water a day.[1]

Impoundage in reservoirs during dry periods and running off to streams during heavy rainfall is dependent on fairly heavy rainfall at intervals, and the proximity of a stream which is large enough to carry off the salt water during flood periods without danger of pollution. The method of running off directly into streams is also dependent on there being, within reasonable distance, a stream large enough to take all salt water without incurring any risk of stream pollution.

Pumping down a well into barren underground formations or cavities is adaptable where there are suitable subsurface formations or underground cavities into which salt water can be pumped at a relatively low pressure and without danger of clogging by precipitation of salts.

An example of how the salt water disposal problem can be solved economically by the latter method, that is, pumping into a barren subsurface stratum, is that of the Peters Petroleum Corporation of Tulsa, Oklahoma. On one of the leases of this company there are a number of small producing wells, three of which, siliceous lime wells about 2500 feet deep, contribute the bulk of the 500 barrels salt produced daily by all the wells. There is a large pond on the lease with a capacity of several hundred thousand barrels of water which previously had been used for salt water storage and was sufficient to care for requirements for a time. However, the amount of water made by the wells

[1] "Disposal of Salt Water," by S. W. Oberg, A. P. I. Paper, 901-4E.



Salt water tail pump hooked up to a producing well. This pump handles 1000 barrels of salt water daily. This aomunt of water is made by two wells, one of which is the well here shown.

Disposal Leases « « «

By K. C. SCLATER

gradually increased to the point that a new source of salt water disposal became necessary. It was known from the logs of the wells drilled that a porous sand carrying salt water underlaid the lease at a depth somewhere between 600 and 800 feet. This suggested the feasibility of drilling a well to this horizon into which the salt water could be pumped. A well was therefore drilled at a point convenient to the salt water pond and near where the water-bearing horizon had been definitely observed. At about 500 feet an oil sand was penetrated and on test proved to be good for commercial production. This well was completed at about 500 feet as a producing oil well. Another site was chosen for the salt water well in an area on the edge of the lease where it had been ascertained that the shallow horizons were not productive. This well was drilled to a depth of 778 feet. The casing, 650 feet of 8-inch, was cemented to protect overlying formations. This left about 128 feet of sand exposed in the well.

A pressure of 500 pounds per square inch was required at the start to force the water into the sand at the rate of about 500 barrels a day. After about four months the required pressure for this quantity of water gradually diminished to about 250 pounds. A 3-inch by 8-inch power pump belt driven from a gas engine is used for pumping the water through about 1500 feet of 2-inch line and down the well. Why the pressure required to inject the salt water into the sand has diminished is not definitely known. It may be on account of the solutive action of the water on cementing material in the sand, or because of the formation of channels in the sand surrounding the well. Certainly there appears to be no detrimental effects from clogging of the pores by the precipitation of salts.

In some areas where this method of salt water disposal has been tried, clogging of the pores by precipitation of salts has been a serious drawback—so serious, in fact, as to cause the method to be abandoned. The direct result of salt precipitation in the pores of the sand in the vicinity of the well is to reduce the intake capacity of the well and increase the pressure to the point where pumping costs become prohibitive. An important consideration, therefore, before any installations involving large expenditures are started, is this factor of possible precipitation of salt in the sand pores to the extent that serious clogging results. This may involve an investigation of the character of the formation and the nature of the materials of which it is composed. Also geological considerations may enter as to the formation into which the water is to be pumped and a decision obtained from the proper authorities as to the advisability of the proposed project.

Salt water gathering pond on a lease of the Peters Petroleum Company, from where the water is pumped to the well as shown.

A volume of 500 barrels of salt water daily is pumped into this well at a pressure of 250 pounds per square inch. It takes care of the salt water produced by a group of wells on a small lease of the Peters Petroleum Company.

Salt water gathering pond from which the water is pumped to the well shown above. In the center of the pond can be seen the strainer box over the pump suction line.

The total cost of the complete salt water disposal equipment and installation is estimated at $2700. Besides the low initial cost of the well and complete pumping equipment, maintenance and running expense is small and consists mainly of fuel and water costs. No extra labor is required, as the pumper on the lease looks after the well and pumping equipment.

On another small lease of the Peters Petroleum Corporation there are two wells that together produce about 1000 barrels of salt water a day. Here conditions were favorable for the drilling of a shallow well to a barren water sand for the disposal of the water. A well was drilled to 564 feet. It has a string of 8-inch casing landed and cemented at 558 feet. This well, although it has only about six feet of sand exposed, has taken water at the rate of about 1000 barrels a day at a pressure which varies from 50 to 350 pounds per square inch. This wide range of pressure has been characteristic of the well since the start. So far as can be observed, there is no perceptible change in the ability of the well to take water since it was first put into service.

REFINING POWELL CRUDE

By LESTER LANDMAN

Chief Chemist, Central Texas Refining Co.

POWELL crude is a sweet crude of approximately 34 gravity and contains about 30 per cent gasoline and 16 per cent kerosene. The oil is of the paraffin family with the gas oil and fuel showing comparatively high cold tests. The sulphur content of the crude and of the various cuts taken from the crude are low; gasoline 0.02 per cent, kerosene 0.04 per cent. This crude has little or no lubricating oil content.

The Central Texas Refining Company operates five refineries on a variety of Texas crude oils:

Angus Refinery	***Powell Crude***
Minerva Refinery	***Minerva Crude***
Brownwood Refinery	***Brownwood Crude***
Midland Refinery	***West Texas Crude***
Luling Refinery	***Luling Crude***

A very efficient method of skimming this crude oil has been worked out by the management of the company at their refinery running this crude. This refinery is located at Angus, Texas, seven miles south of Corsicana.

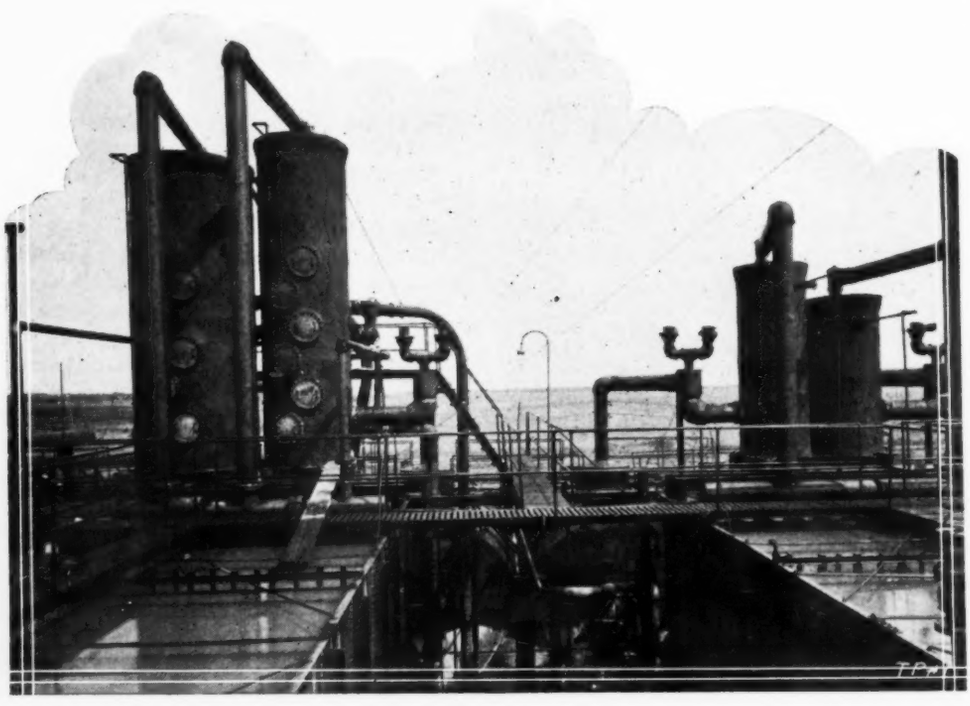
The equipment employed at this refinery follows:

2—4′x60′ bubble towers having 21 trays
1—4′x45′ bubble tower having 16 trays
1—5′x15′ bubble tower having 6 trays
2—pipe stills each having 972′ of 3″ tubing
3—shell stills used continuously in conjunction with the two pipe stills.

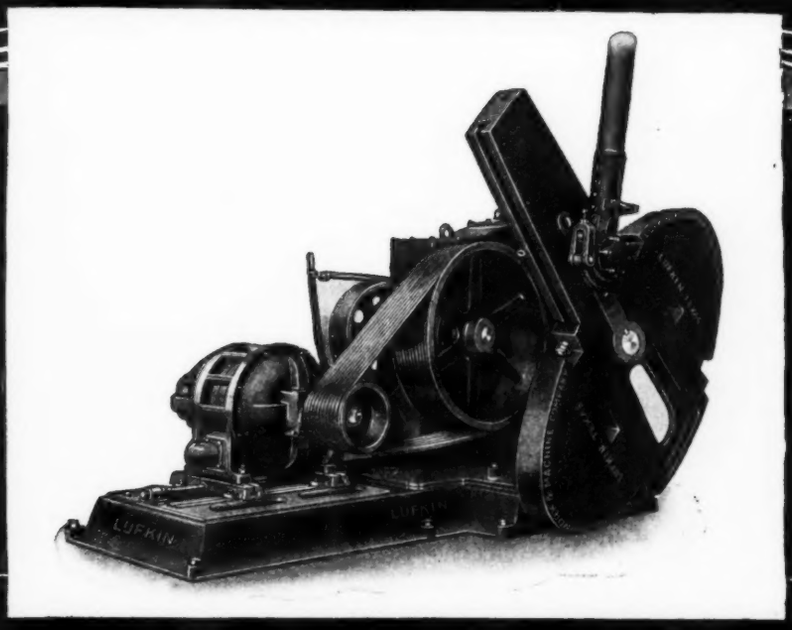
The procedure of skimming the crude is as follows: The crude oil is pumped from the 55,000-barrel storage tank through a heat exchanger of 2-inch pipe surrounded by 4-inch pipe and exchanges heat with the hot fuel coming from the bottom of No. 5 still; the crude is raised to approximately 350 degrees F. before it reaches the first pipe still. After reaching the pipe still the oil is heated to approximately 450 degrees F. and gasoline is taken off the first tower. The bottoms from the first tower are backtrapped into the second pipe still, from the tower of which another gasoline stream is taken off. The bottoms from the second tower are backtrapped into an expansion drum, where they are picked up by a pump and put into the first shell still, from the tower of which a cut of 44 gravity kerosene is taken. The oil is then taken to the second shell still, from the small tower of which (containing 6 trays) a gas oil cut is taken. In the last still fuel oil is obtained and has a gravity of approximately 26 degrees.

The first stream taken from this crude from the first tower is doctor sweet and free from corrosion; the second stream is slightly off doctor, but free from corrosion; the third, or kerosene stream, requires a slight acid treatment (2½ pounds per barrel of 66 degree sulphuric acid).

On account of the large size of the towers used, the products made are exceptionally close cut. The percentages of gasoline and kerosene made from Powell crude in this plant exceed by 2 to 5 per cent the yields obtained by using a Hemphel column in laboratory distillation.



Modern Refining Equipment in Texas.



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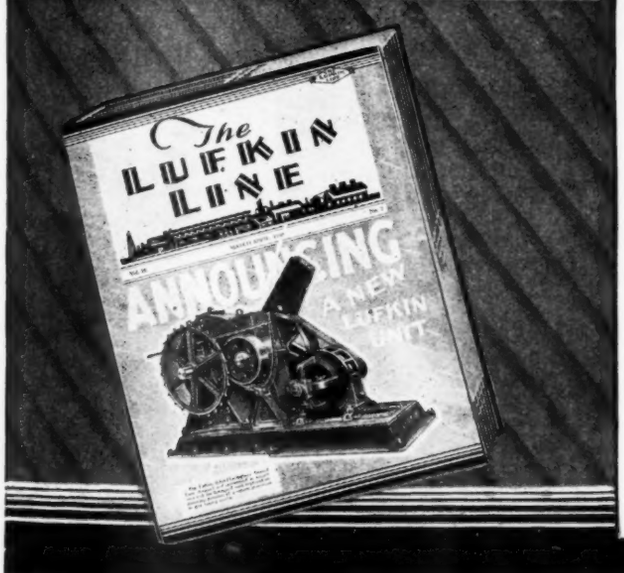

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Methods Used for

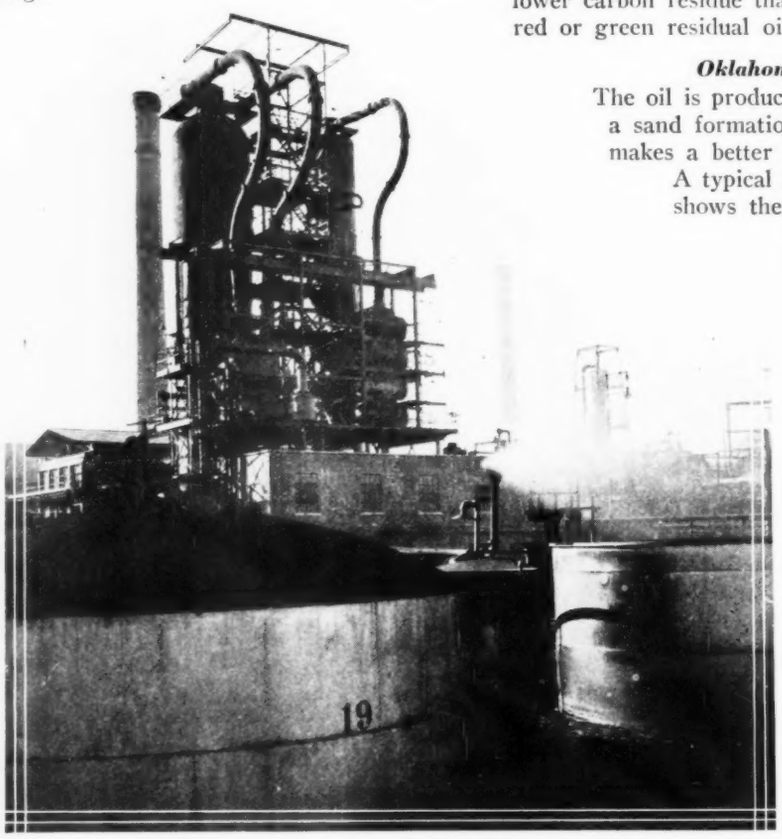
Processing Oklahoma City Crude

By F. R. STALEY

SEVERAL new refinery units are under construction and others are being planned for processing Oklahoma City crude. The enormous potential production, over 800,000 barrels per day, has stimulated much work to date among refining technologists employed in the research and development departments of the various engineering firms and oil companies concerned. This oil can be processed to yield very high quality lubricants in addition to low sulphur gasoline, kerosene and gas oil.

Single Flash Distillation

The modern procedure for distilling crudes containing lubricating fractions is single flash distillation in a pipe still in connection with towers for the separation of the various fractions. The crude is reduced to long residuum or cylinder stock in a steam atmospheric unit or in a vacuum unit to tar residue. In the latter case two-stage distillation is used, in which the naphtha, kerosene and light gas oil cuts are separated with steam in a tower under atmospheric pressure, and the hot residue is further vaporized in a second tower under reduced pressure for the separation of the various lubricating fractions as wax distillate and overhead stock. The final residue, or tar, usually varies from 5 to 10 per cent of the crude.



Two-stage atmospheric vacuum distillation unit.

Residual vs. Overhead Stocks

The conventional procedure for processing Mid-Continent paraffine base oils in manufacturing heavy lubricants is to treat the reduced crude, either long residuum of 450 degrees F. flash test, or cylinder stock of 520 degrees F. flash test, with concentrated sulphuric acid (93 per cent or 98 per cent). The economic limit to this procedure is the treating loss and the quantity of acid required. Consequently, this procedure for manufacturing bright stocks is limited to a few high-grade green crudes showing a low treating loss. For crude containing more asphaltic compounds a wax distillate cut is taken overhead in a steam atmospheric distillation and the residue, often containing valuable heavy lubricants, used as fuel or cracking stock. Recent developments in the single flash, two-stage atmospheric vacuum unit enable the refiner to separate all the lubricating bodies from the tar or residue in lower grade crudes and to closely fractionate the distillate into the desired cuts.

New Motor Oils Vacuum Distilled

On account of the superior qualities of the resulting motor oils, such as lighter color, lower carbon residue and lower volatility, some refiners are distilling all of their lubricants overhead under vacuum, even from such crudes as Ranger and Burbank, which are usually processed by treating the reduced crude. There is a definite tendency among refiners to manufacture lighter colored oil having lower carbon residue than the conventional dark red or green residual oil.

Oklahoma City Crude

The oil is produced both from a lime and a sand formation. The sand production makes a better grade of lubricating oil. A typical sample of the sand crude shows the following tests:

Gravity, 37.8 A. P. I.
Sulphur, 0.3%.
Pour Test, Below Zero.
Tar, .04%.
Color, ⅛ T. R.

Engler Distillation

I. B. P.	146° F.
15%	284
28	392
34	437
40	500

The following approximate yields are obtained by steam atmospheric distillation:

U. S. Motor Gasoline, 28%.
Kerosene, 41-43°, 15%.
Gas Oil, 34°, 20%.
Long residuum, 35%, 440° flash.
Loss, 2%.

This crude can be processed to yield a high quality lubricating oil of light color, low sulphur, and carbon content, and the temperature-viscosity relationship as well as that of the boiling range-viscosity equals that of the best Mid-Continent oils.

A study of the two methods of refining the crude indicates that the better procedure is the two-stage atmospheric vacuum distillation producing overhead stock, rather than to treat the reduced crude, due to the heavy acid treatment necessary and the heavy sludge loss. If the tar is separated by vacuum distillation, the overhead stock can be processed at a cost which will not exceed that for most other Mid-Continent bright stocks.

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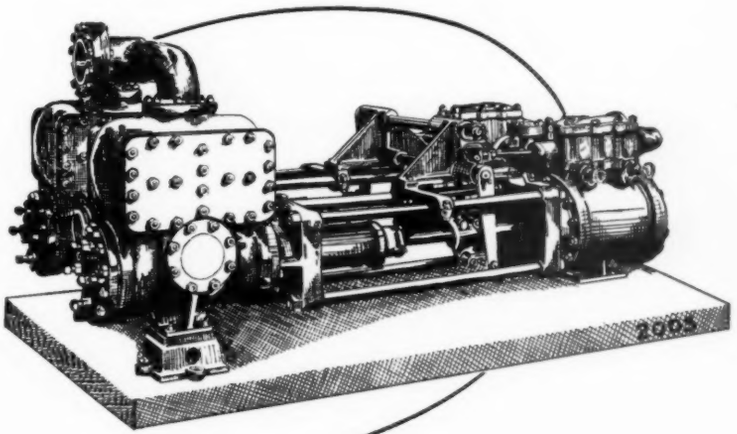

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TABLE No. 1

	Residual Stock	Overhead Stock
Gravity, A. P. I.	24.5	24.1
Flash, ° F.	495	545
Fire, ° F.	560	630
Color	7	5
Vis. 210	130	130
Pour	10	5

TABLE No. 2

Reduced Crudes

Crude	Bradford	Ranger	Okla. City
Gravity A. P. I.	28.0	22.5	25.0
Flash ° F.	435	435	435
Fire ° F.	500	495	495
Vis. 210°	78	92	95
Pour	75	70	80
Carbon Residue	1.3	3.2	3.5

After separating the overhead stock by vacuum distillation, this stock is processed by giving it a sulphuric acid treatment of 15 pounds per barrel, resulting in a sludge loss of eight per cent for a finished bright stock of 155 viscosity Saybolt at 210 degrees F. with a 6-7 N. P. A. color. The overhead stock can be dewaxed before or after the acid treatment, depending upon the pour test required. For pour tests between 20 and 30 degrees F. the conventional procedure can be used, but for zero pour test stock it is better to dewax before acid treatment.

Acid-Treated Residual

In order to produce a similar colored stock from the residue or reduced crude, from 50 to 60 pounds of sulphuric acid is required per barrel, which results in a sludge loss of 40 to 50 per cent of the oil treated. If the oil is contact filtered with clay, the quantity of acid might be decreased to 45 pounds per barrel by increasing the clay used, but this is not usually an economical procedure.

A comparison of the two methods of refining shows yields of 9.5 per cent of 155 viscosity bright stock by treating residual oil, and a yield of 11.5 per cent by treating the vacuum overhead stock. The latter product has a higher flash and a lower carbon residue. A finished overhead bright stock from Oklahoma City crude shows the following:

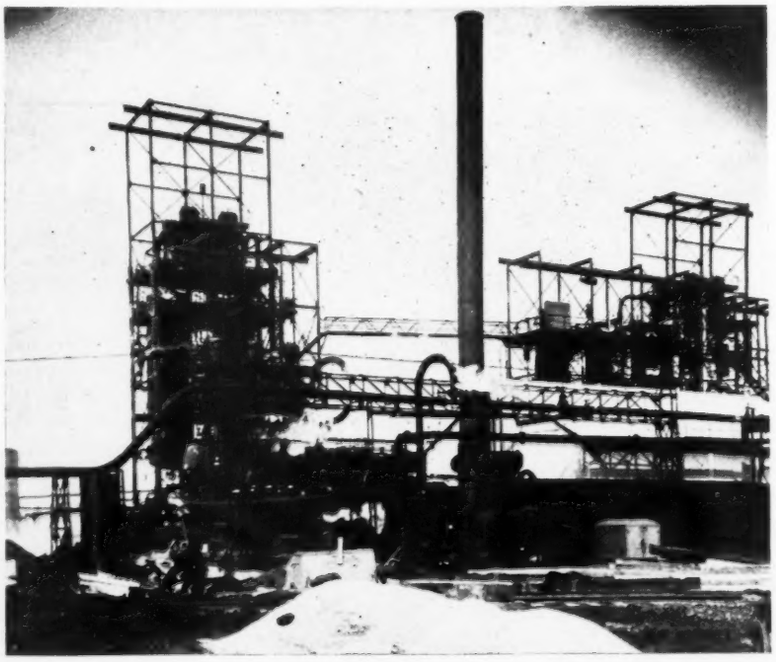
Gravity	23.5 A. P. I.
Flash	560° F.
Fire	630° F.
Viscosity 210	160
Pour	10
Color	6 N. P. A.
Carbon res.	1.7%

Another laboratory processing this crude by the two methods reports the comparative results shown in Table No. 1. Unfortunately, the carbon residue was not reported.

The residual stock was treated with 55 pounds of sulphuric acid (98 per cent) per barrel, and the overhead with 15 pounds per barrel.

A study of the economics by the two methods, considering the losses, the acid required, and the quality of the finished products, shows the vacuum distillation to produce an overhead stock has the advantage in each case.

Many refiners are making every effort to produce the highest possible quality motor oil from their crude, and installations of vacuum pipe stills are now processing the highest grade crude oils, as Pennsylvania, Ranger and Burbank. This process improves the color, volatility and carbon residue. Research work to separate the more unsaturated constituents by selective solvents and fractionation, shows that the viscosity-temperature, and viscosity-boiling point relation can be improved on mixed base oils.



Cracking Stills, Standard Oil Co. of Ohio's Cleveland refinery.

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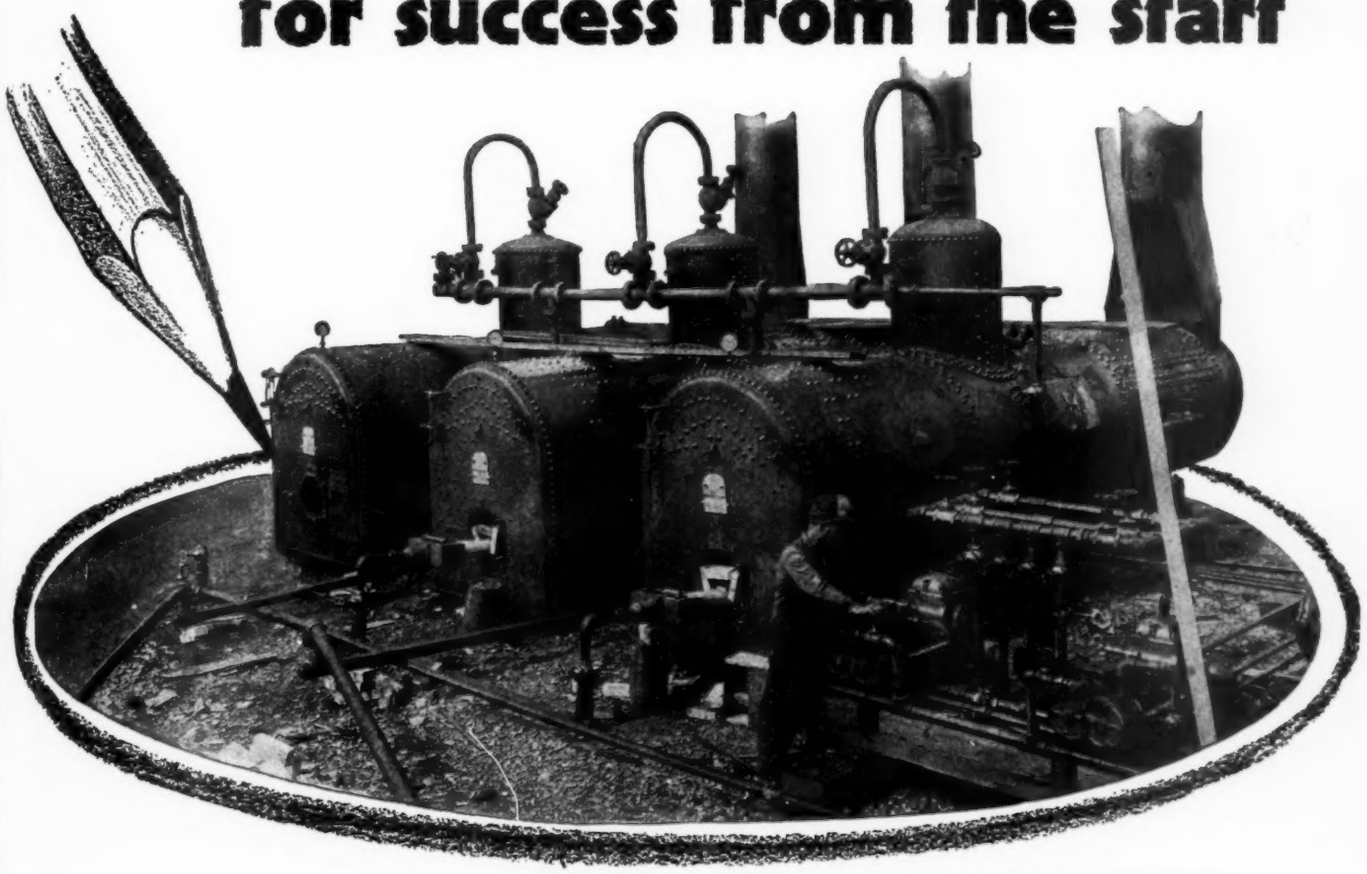

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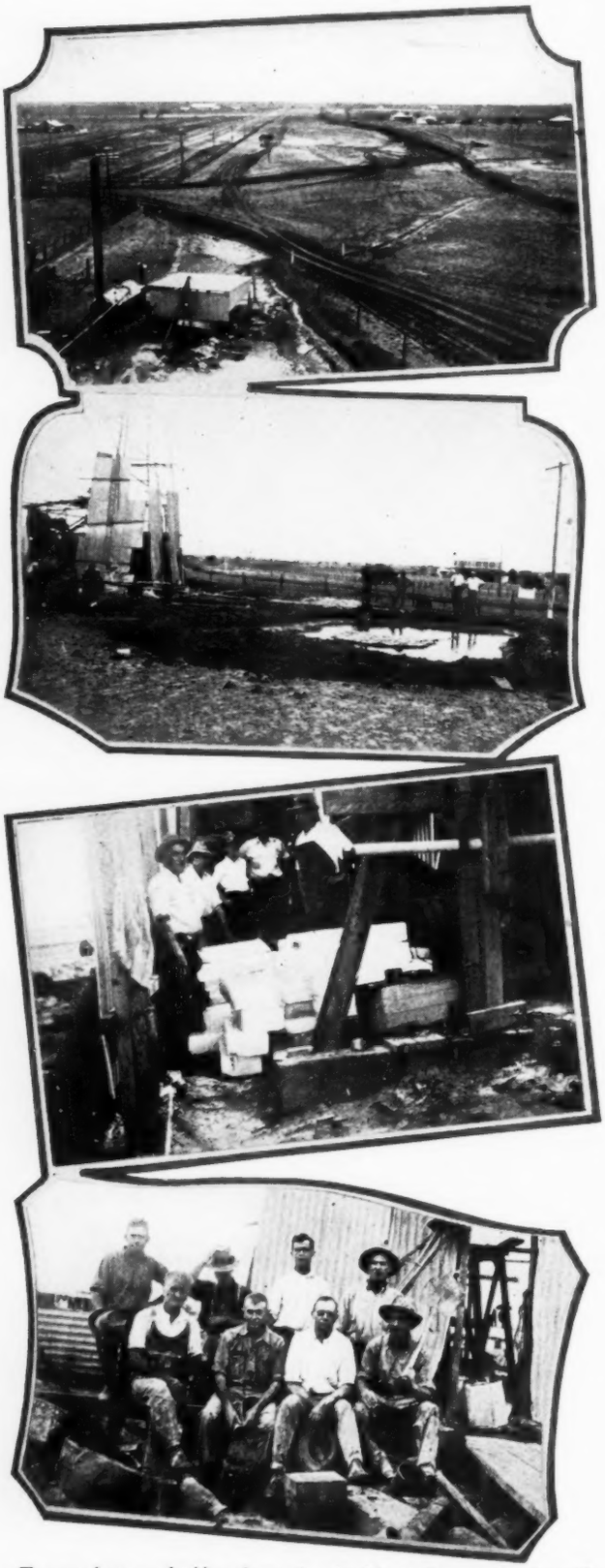
More Attention Now Given to Drilling Prospects in Australia

By PAUL E. ROYLE,
Boring Supt., Oriomo Oil Co., Queensland, Australia



Top to bottom, looking from the derrick at Longreach, Australia. Surface tank to hold drilling water. One ton of ice used as an adjunct to cementing. A group at the well—front row, left to right, C. Ogilvie, Govt. representative; Mac D. Royle, chief engineer, and Paul E. Royle, boring supt. of the Oriomo Oil Co.

OIL boring in Australia and New Guinea has unfortunately been carried on in a haphazard manner for a number of years and it is claimed by many eminent geologists that this is the reason that Australia has not yet entered into her rightful place amongst the oil-producing countries of the world. It has, however, been practically proved that there are favorable places for the accumulation and retention of oil and already gas carrying a pint of petrol to one thousand cubic feet has been produced at Roma in Queensland, while in New Guinea, at Matapau, up to ten gallons per hour of oil carrying 41 per cent of gasoline has been produced at a depth of less than 500 feet.

Queensland is a pastoral country and mostly given to grazing. The interior though well grassed is poorly supplied with natural water, but fortunately many years ago it was found that Artesian water could be tapped. The depths of the bores and the size of the flows vary, but the variation is gradual and the contour of the basin can be traced. The depths range from 100 feet to 7,005 feet and the flows from a few gallons per hour to 2,000,000 gallons per day. The squatters who were paying for the boring naturally wanted water and being unused to oil fields, had very little idea of the chances of getting oil. Therefore, when a bore was put down and perhaps a driller with oil field experience noticed a petroliferous smell or a showing of oil his enthusiasm was damped by his employer.

It is only in recent years that any interest has been taken in the matter and the first field to be worked was Roma as there was a water bore there which had caught fire over 20 years ago. Enthusiasm being aroused, money was available, but only for bores in the Roma district. All the while, however, geologists and a few enthusiasts were working quietly and when in 1925 a bore being sunk for water in the town of Longreach started to throw up oil in large quantities it was possible to raise the money for an oil bore. The depths of the sands where the oil was encountered were of course known; it was recorded by the driller that the oil formation extended from 3,227-3,242 feet.

The bore to tap the oil was started last year and when the artesian flow was struck at 2,490 feet, quite a showing of oil was found. The bore finally reached the looked-for depth and a formation shutoff was made and a pilot hole drilled. The sand was located at exactly the same depth as in the water bore. Only a few inches of the sand was opened up and the water was gradually lowered in the hole until when 1,500 feet from the surface the oil was making against the water pressure. The pilot hole was then plugged up with plastic mud and cement and the work of cementing off the artesian water is now in progress.

The problems to be faced in the cementing are rather great as the circulation is very poor, this being caused by many hundreds of feet of bad caving country between 1,400 and 2,000 feet. Also it is believed that in Queensland we have probably the hottest subsurface temperatures in the world. At 3,220 feet the temperature is over 181 degrees F. and the available cement takes the initial set in 20 minutes at this heat. Various tests have been made and it has been proved that it is possible to cool the hole by pumping large quantities of water down through production tubing and back through the bore tube. When the water is flowing from the bore the temperature of the flow at the surface is 160 degrees F.

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INTERESTING Observations Made in

FATIGUE TESTING SUCKER RODS *to* DESTRUCTION

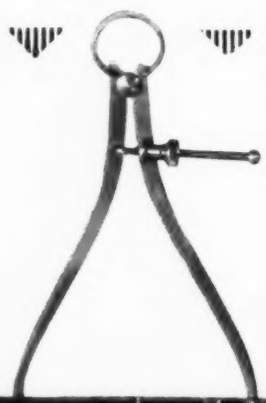
By P. J. McCULLOUGH[1]

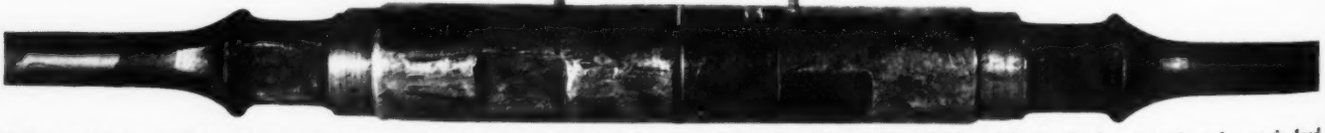
THE object in making the test described in this article was to try to measure the differences in ability between different kinds of A. P. I. standard oil well sucker rods to withstand fatigue caused by the high-speed pumping of excessively heavy fluid columns in oil wells. It seems there had never been a machine developed and placed on the market suitable for fatigue testing a string of sucker rods, so one was improvised by laying two 120-foot strings of 5-inch by 10-inch I-beams ten inches apart. At one end of these beams there is a three-cylinder hydraulic pump driven by a 15-H. P. variable speed electric motor. The hydraulic principle of the pump was not used, so the three cylinders and two of the connecting rods were removed.

The power stroke is delivered by a 4-inch crankshaft, a connecting rod and a bell crank which imparts horizontal motion to a ball and socket assembly to which one end of the sucker rod is secured. There is a coiled spring arrangement at the power end of the pair of beams with a capacity of 16,000 pounds, so that any predetermined minimum or datum load within this range can be applied. If at any time the repeated minimum loadings fail to register correctly it will be indicated by the failure of a blinking light. At the opposite end of and between the I-beams is located the maximum load weighing scale which is movable to any place throughout the length of the pair of beams, its location depending on the length of the string of rods to be tested. This scale consists of an 8-inch pipe in which there are two clusters of standard G freight car buffer springs with a total capacity of 60,720 pounds. The end of the pipe is capped with a ball and socket joint arrangement to which the end of the sucker rod is secured.

All springs were carefully calibrated from time to time during the test and found to weigh the same each time throughout their full range. Maximum or peak load adjustment within the capacity of the springs may be made by turning a nut on a 2½-inch bar which passes through the springs and a couple of plates anchored to the beams. If the repeated maximum loads do not register the same within very close limits during the test, it will be indicated by the failure of a blinking light like the one used for the datum load. The machine can be set for any load-cycle speed between 16 and 80 per minute. There is a stroke counter and a cutout switch which automatically stops the machine when the string of rods part. The results obtained so far seem to indicate that oil well pumping loads can be duplicated so far as the number and kind of breaks in strings of sucker rods are concerned. However, if the peak load in the machine were kept as low as it is supposed to be in so-called heavy pumping wells, that is, about 15,000 pounds, in place of 24,000 pounds, which is the maximum working load selected for the test, it is almost certain the rods would last much longer in the machine than they would in the well, indicating an unknown stress quantity difficult to determine while pumping oil. These unmeasured forces may be due possibly to accidental team-work of irregular stresses that necessarily develop from time to time when carburetor and spark timing adjustments are being made, which may cause the engine to kick back, also when or if the stroke and speed of the pump are temporarily increased to "head off" salt water following a shutdown for repairs and to the so-called wave effect in the string of rods similar to that which causes draft-gear failure in a badly handled train of freight cars. With so many uncertainties so far as stress and strain are concerned, it is not likely that the destructive effect of fatigue in a string of rods would ever be closely duplicated even in the same well. Therefore, in order to determine which is the best rod to be used to meet special conditions, the different kinds, that is, galvanized, heat-treated, alloy, etc., could be evenly mixed or alternated as they are run into the well. The A.P.I. standard screw thread should eliminate any inconvenience in connecting up a string of sucker rods in this way, thereby making it a reliable method of selecting the most economical rod to be used where pumping conditions are such that the useful life of the rod is at best very short.

Three-quarter-inch sucker rod broken under a fatigue load of 5,000 pounds to 24,500 pounds. Applied 1,810,788 times at the rate of about 65 times per minute. Note crescent-shaped zones on face of fracture.





Sucker rod joint assembly, showing method of measuring amount of stretch in a 1 1/16-in. by 2¾-in. threaded pin while in the boxes and under static load.

[1] Engineer, Scullin Steel Co., St. Louis, Mo.

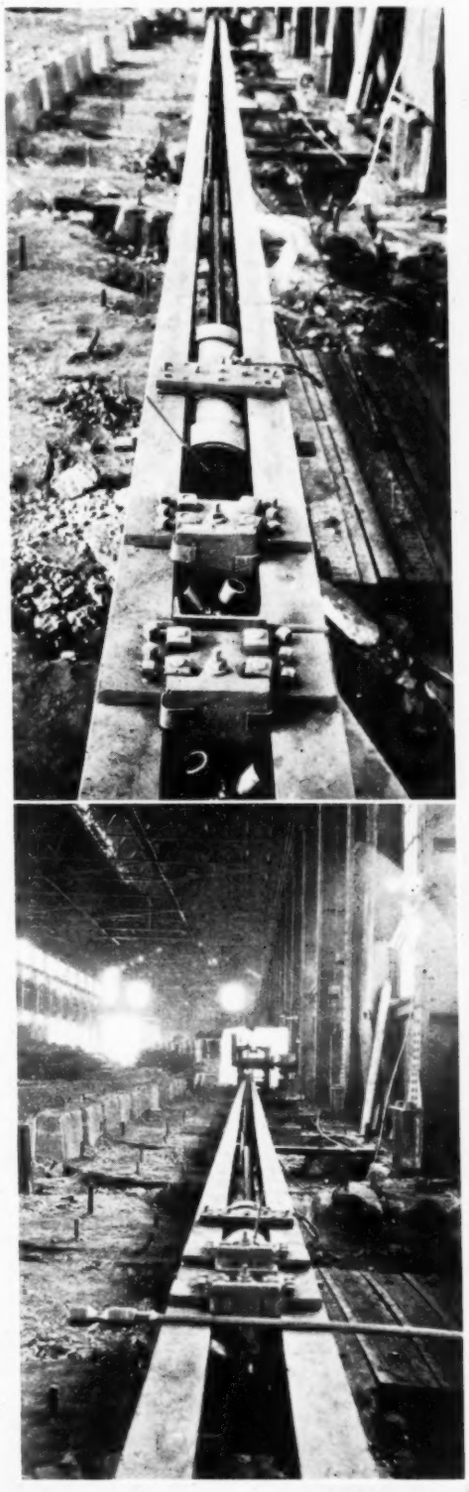
Stress Analysis of Screw Thread

If it were possible to make a threaded pin and nut, box or coupling with exactly the same number of threads per inch and of the same pitch diameter, there would be a perfectly uniform distribution of pressure against the pressure face of all threads in mesh. A perfect thread fit of this kind would be thrown out of adjustment by wrenching or snapping the joint together, because this force would stretch the threaded pin and also shorten that portion of the box which is under compression.

As the fiber stress in a coupling of this kind is never uniformly distributed, it is not possible to calculate the amount of deformation, so actual measurements were taken to see if it was sufficiently great to produce critically high stress in the last threads to enter the box and at the same time relieve the pressure in the first threads to enter the box. These measurements were made with a specially prepared box and pin, consisting of a 1⅛-inch diameter pin 2¾ inches long, threaded on each end with A. P. I. standard 10-pitch thread and drilled in the center at each end ⅜-inch deep to take a tight-fitting ⅛-inch piece of drill rod long enough to stick through and out beyond the end of the couplings to permit measuring the length of the pin with a micrometer caliper. Measurements of length were taken of the pin and couplings before and after the couplings had been screwed together with sufficient force to stretch the pin and compress the couplings. The pin was stretched .015-inch and the couplings compressed .002-inch, so that after snapping together a perfectly machined sucker rod joint with 10 threads per inch we have 10 minus threads per inch on the pin and 10 plus threads per inch in the box, with the result that, due to a misfit, practically all the load is carried by the last couple of threads to enter the box.

Quite a number of specimens of broken sucker rod pins were collected from deep oil wells in Oklahoma and Kansas. By cutting vertically through the center of the pin and box it was plainly observed in some specimens that two or three threads at the end of the pin were actually under pressure in opposition to the two or three threads at the end of the box where the fracture occurred, indicating a difference in thread pitch between the pin and box, the thread pitch on the pin being very noticeably the coarser of the two near the fracture.

If threads are cut with a badly worn die or tap, there will be a noticeable change in the pitch diameter of a screw or nut, but this should not cause a change in thread pitch. Therefore, it seems probable that the coarse pitch of the threads on the broken pin in question might be due to the pin being stretched when the joint was snapped together, or during the process of pumping.



Top—Minimum load spring with ball and socket for holding rods on sucker rod testing machine. Bottom—Sucker rod testing machine in operation.

Knowing the modulus of elasticity and the amount of stretch in a piece of steel, it is a simple problem when the size and shape are known to determine the number of pounds required to stretch the piece within its elastic limit, provided the stress is uniform throughout, but in the sucker rod joint it is never uniform, hence the desired amount of stretch was produced with a static testing machine and measured by drilling a ⅜-inch hole in the side of each of two boxes, the holes being in line with the end of the sucker rod pin so a caliper could be inserted. A standard sucker rod was screwed into each box, making a double joint assembly consisting of the 1⅛-inch threaded test pin in the middle, with one box and one sucker rod on each end. The rods were placed in the grips of the machine and the load applied. At 31,700 pounds the pin stretched .015-inch, the same as when the joint was snapped up extremely tight with the wrenches. At 32,900 pounds the pin stretched .026-inch. This amount of stretch would likely cause an objectionable misfit between the threads of the pin and box.

Static and Fatigue Fractures Compared

The specimens used in this test were made of rivet steel 1⅛-inch diameter and threaded with an A. P. I. standard die.

No. 1 specimen was broken in the fatigue machine under a load ranging from 5,000 to 24,500 pounds, applied 1,924,558 times at the rate of about 65 strokes per minute. There was very little reduction in

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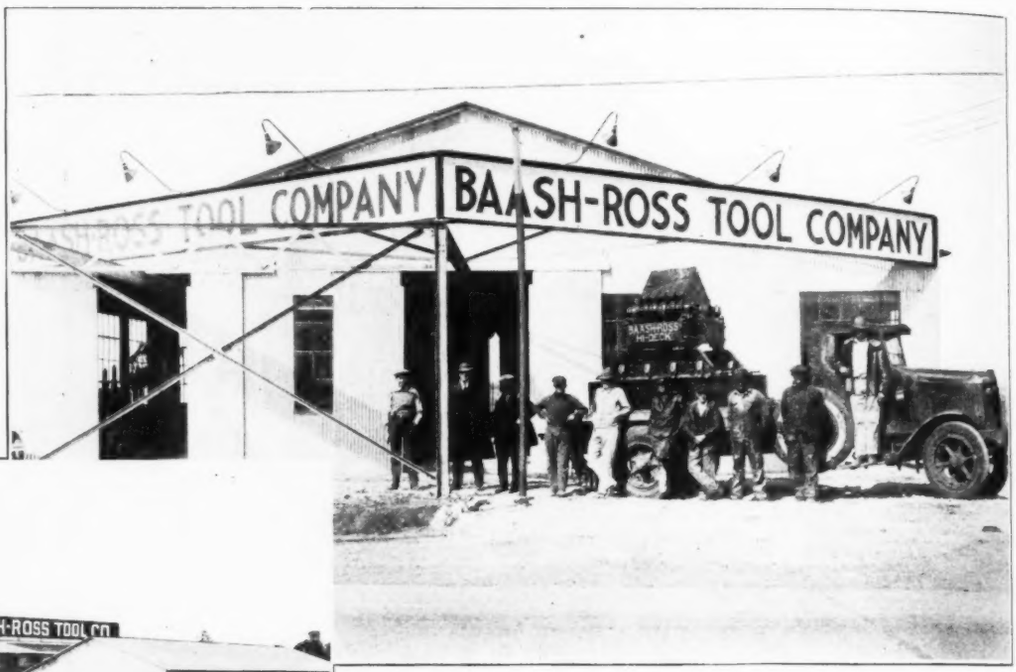

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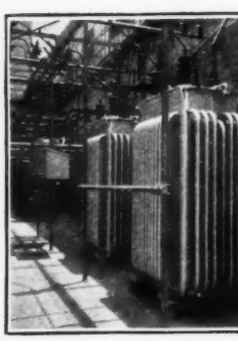

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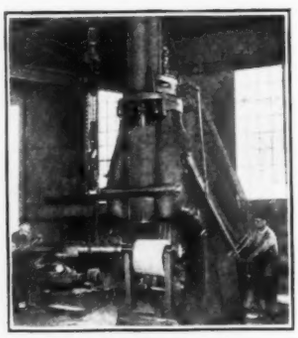

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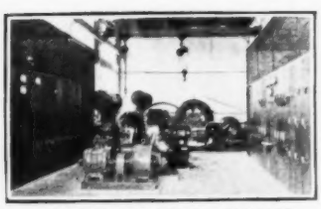

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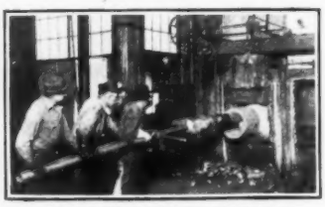

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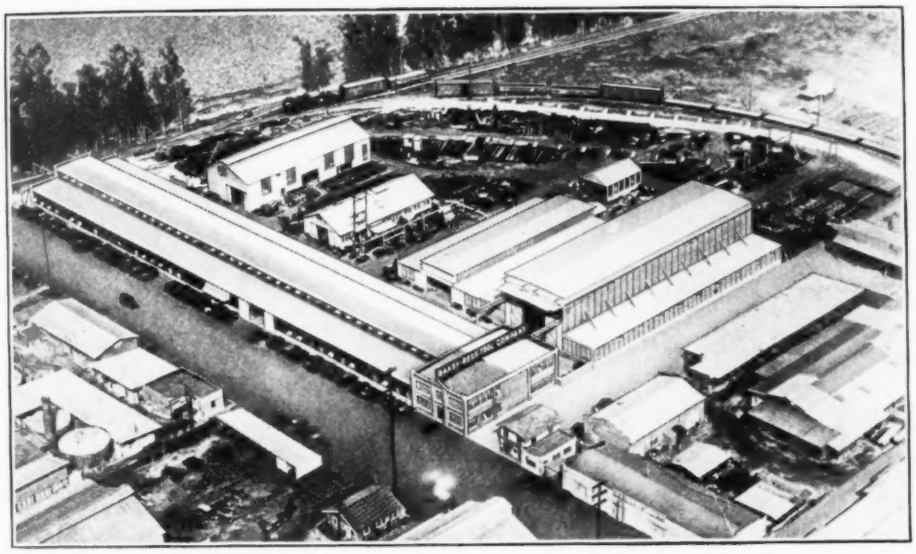

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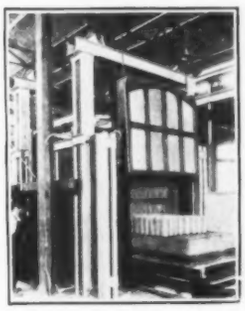

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area or elongation, which is characteristic of all specimens broken by fatigue, either in a machine or actual service.

No. 2 specimen was broken in a static machine under a load of 67,500 pounds. There was a considerable reduction in area.

No. 3 specimen was necked down under a static load of 63,700 pounds to show the effect it would have in altering the thread pitch, which changed from the standard 10 pitch to about 7 at the smallest part of the neck.

Strain Gauging Joints for Permanent Set

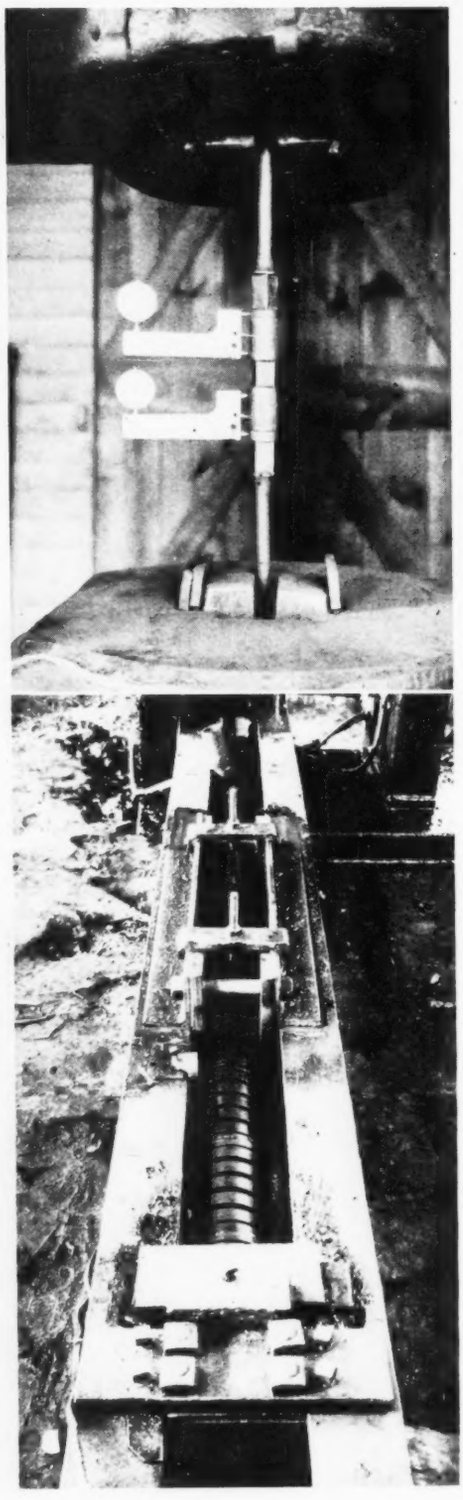
So far as could be determined, joints did not work loose during the test unless the threaded pin stretched enough to cause release of pressure at the shoulders.

In testing to determine the effect of tight and very tight wrenching of a sucker rod joint, it was determined that the looser joint would take a permanent set under loads from 1000 pounds to 20,000 pounds, while the very tight joint took no set at all. Two strain gauges were used, one being placed at each end of the box across the joint made with the shoulder of the pin. Under a load of 20,000 pounds the gauge across the very tight joint indicated a stretch in two inches of .0009-inch and moved back to zero when the load was reduced to the initial load of 1000 pounds, while the gauge across the looser joint registered .0123-inch at 20,000 pounds and indicated a set of .0057-inch at the 1000-pound initial load, which loosened it enough so it could be unscrewed by hand without wrenches after it was taken from the testing machine.

Pin Failure Due to Loose Joints

The results of a number of static tests seem to indicate that it is possible to produce a considerable difference in the fatigue-resisting qualities of sucker rod joints by snapping them together with a considerable difference in leverage or force applied at the sucker rod wrenches; that is, under a given fatigue load the loose joint will receive a greater amount of fatigue than is received by the tight joint. Therefore, the threaded pin in a tight joint should last longer than it would if the joint were left comparatively loose, because the fiber of the pin cannot move or be worked to any great extent until the load at the pump beam is greater than that load represented by the stress in the pin produced by snapping the joint together.

Tight wrenching, as tests have shown, will produce a change in thread pitch the same as that produced by the peak load caused by the upstroke of the pump, but the effective difference is that in tight wrenching the threads are worked once only each time the rods are assembled, while if the joint is left comparatively loose the threads are worked at each stroke of the pump.



Top—Method of determining permanent set in sucker rod joints. Bottom—Maximum load spring scale with adjusting screw and nuts on sucker rod testing machine.

The popoff valve-spring which is set to relieve dangerous pressure in a hydraulic cylinder is a good example of how a member may or may not undergo fatigue, even though it be under the same amount of load and receive the same number of impulses. The spring would never experience fatigue as long as the pressure is below that required to work the spring, regardless of how many piston strokes are made. The sucker rod pin should experience little or no fatigue as long as the well load is not above that produced in the threaded pin by snapping the joint together.

Protecting Sucker Rod Pins Against Breakage

A number of sucker rod joints were made and tested with a slight difference in thread pitch between the pin and coupling to see if it would improve the fatigue-resisting qualities of the threaded pin.

Information based on previous tests indicated that an A. P. I. Standard 1⅛-inch sucker rod pin with ten threads per inch would stretch a measurable amount while the joint was being tightened, which means that in place of 10 threads per inch while under stress there would be less than 10 threads per inch after the joint had been tightly screwed together or "snapped up." This difference in thread pitch was compensated for by tapping out the box or coupling with a 1⅛-inch tap with approximately 9.95 threads per inch. To be exact, there were 9.927 threads per inch, as this happened to be the nearest that could be obtained to the estimated 9.95 with the lathe

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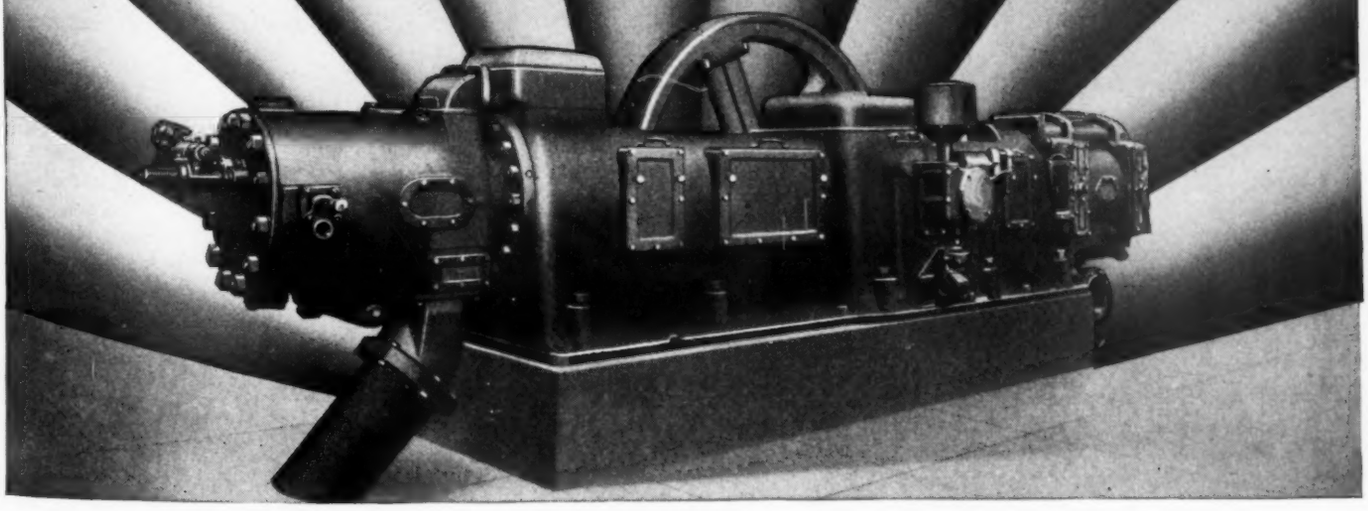

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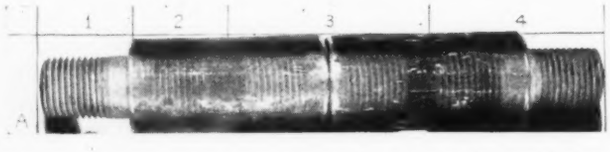
used to make the tap. A pair of special gears were made for the feed mechanism of the lathe, but the coarseness of the teeth prevented producing the exact number of threads estimated.

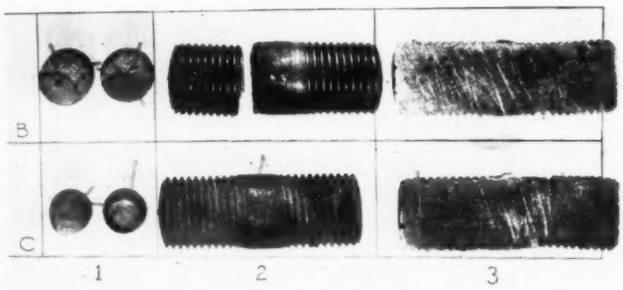
In order to eliminate error in test results due to variation in quality of material, the pins were made 1⅛-inch diameter and 2¾ inches long, threaded on each end with A. P. I. Standard 10 threads per inch. A standard A. P. I. box or coupling with 10 threads per inch was screwed on to one end of each of the test pins and the special box or coupling with 9.927 threads per inch was screwed on to the opposite end of each pin. When these joints were "made up" just at the time the ends of the two kinds of couplings came in contact without being under noticeable pressure, it is assumed that the threads in the standard coupling and the threads on the pin would be a perfect fit and that the coupling with 9.927 threads per inch would be a misfit, but that after making up the joint sufficiently tight to stretch the pin, conditions would become reversed because the pin would then have approximately 9.927 threads per inch, which number would not mesh properly with the threads in the standard box, but would mesh properly in the special box.

In this test there were 45 test pins made—15 of rivet steel, 15 of .20 carbon steel and 15 of .50 carbon sucker rod steel. To date 34 pins have broken, all on the end which was in the standard box except one, which broke in one of the special boxes with 9.927 threads per inch, showing a decided difference in favor of the special 9.927 threads per inch, indicating that where threaded nuts are under compression due to wrenching, as on bolts, studs, rods with shoulders, etc., the thread pitch of the tap with which the nuts are threaded should be comparatively coarse or sufficiently below standard to compensate for change in thread pitch on the screw while it is under maximum tension if uniform distribution of thread pressure is to be maintained.

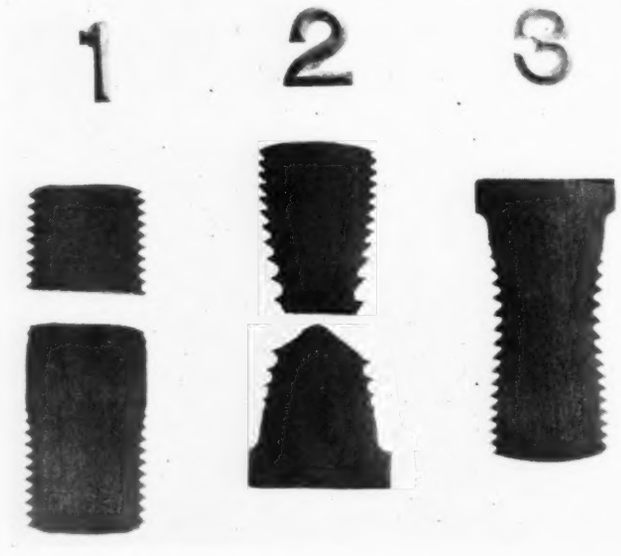
There seems to be no reason for suggesting any change in design or form of the standard screw thread adopted by the National Screw Thread Commission as set forth in the Bureau of Standards Miscellaneous Publication No. 61, or the A. P. I. Standard, but, inasmuch as these standard forms must become deformed due to the strain which is necessarily placed on them when the nuts or couplings are tightened, it seems, as indicated by the tests described herein, that in designing taps and dies an allowance in thread pitch should be made to compensate for change in pitch due to strain, so that thread pressure would be evenly distributed over all threads in mesh while under maximum load.



Phantom view showing position of A 1-2-3-4 pins in special thread tests. A 23 box with 10 threads to inch. A 34 special box with 9.927 threads per inch.



B1—Fatigue fracture of ¾-inch high manganese sucker rods. C1—Section of same rod necked down and broken under a load of 48,600 pounds. C2—Pin with 10 threads per inch used in special thread test. B3 and C3—Pin splits to show where fracture generally starts.

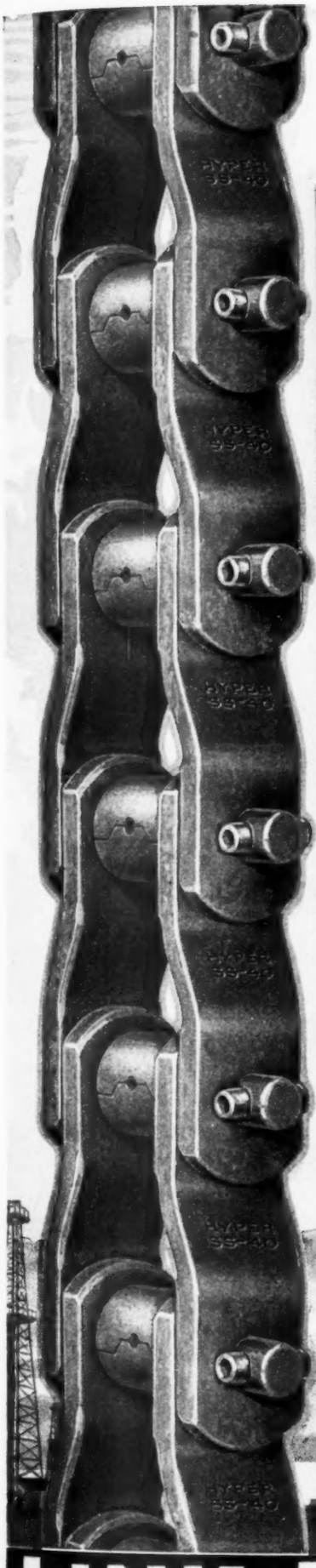


Static and fatigue fractures compared. No. 1, fatigue fracture; No. 2, static; No. 3, stretched to show effect on thread pitch. These pins were threaded with a 1⅛-inch Standard A. P. I. die.

Quality as Indicated by Grain Size

According to some metallurgists various qualities in iron or steel, so far as carbon content and heat treatment is concerned, can be determined by observing the grain size or degree or roughness of the fractured surface. Conclusions based on this information might be reasonably reliable when made by one of much experience. However, the results of a number of fatigue tests seem to indicate that it would be necessary to know also the number of repeated stresses required to cause the fracture, that is, if a piece is broken in a static testing machine or with a single blow or loading, the grain will be comparatively coarse and practically uniform in size over the entire surface of the fracture, but if the load be reduced sufficiently below the elastic limit to make necessary the application of an almost infinite number of loadings to cause complete fracture the grain will be finer, the degree depending on how near the stress is to the ultimate strength of the piece while the fracture occurs.

Photographs of fractured surfaces of pieces broken in the fatigue-testing machine show that at the beginning of fracture in the 1⅛-inch threaded pin, the grain is comparatively fine where the fracture started and progressively gets coarser as the fiber stress increases, which increase is of course due to the reduction in cross-sectional area of unbroken metal in the plane of fracture caused by the progress of the fracture.



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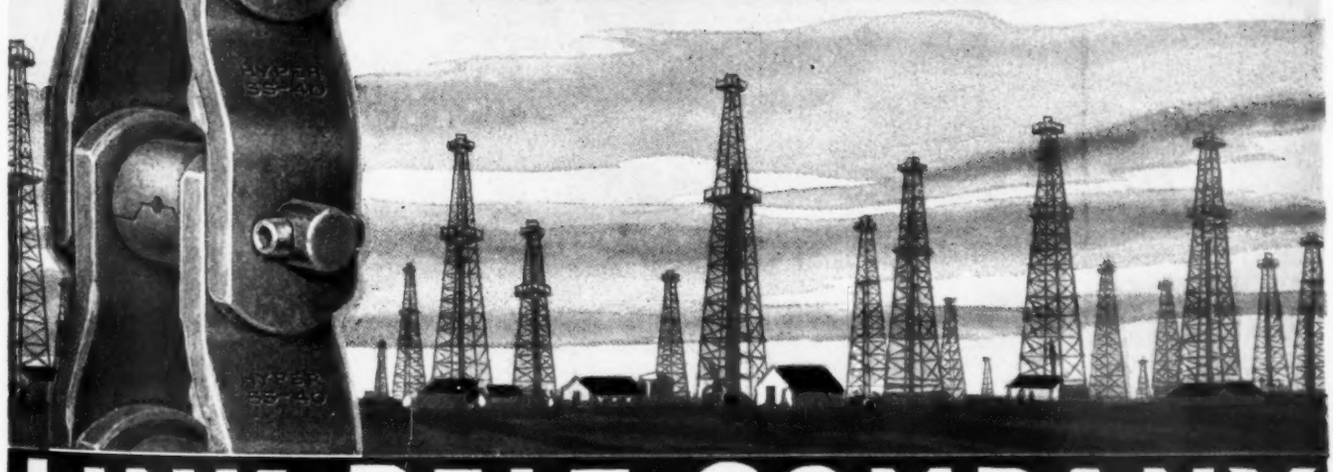

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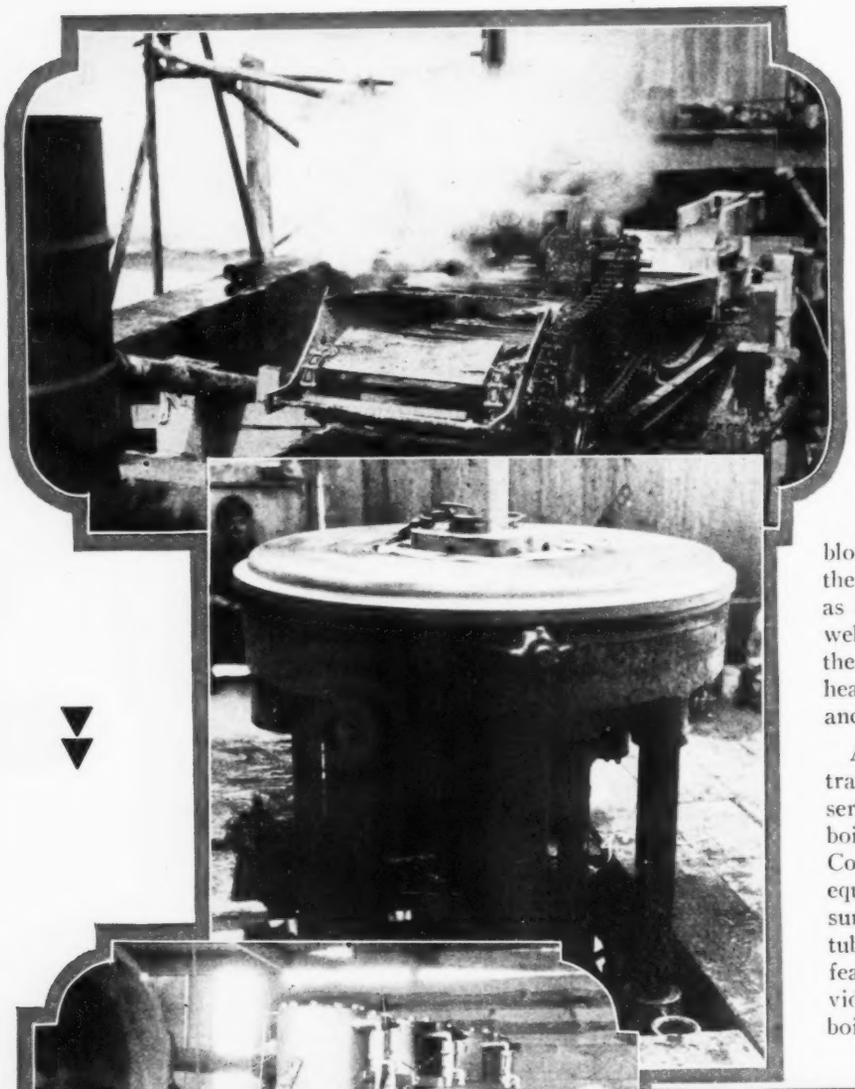
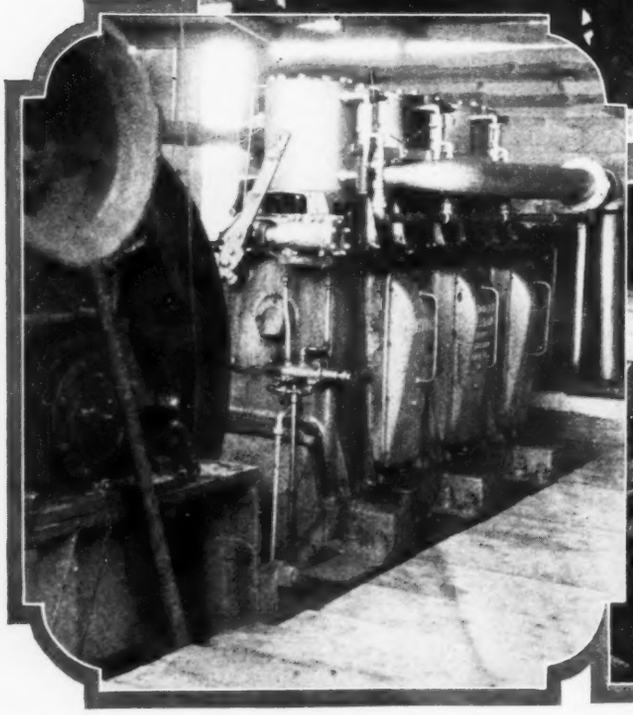
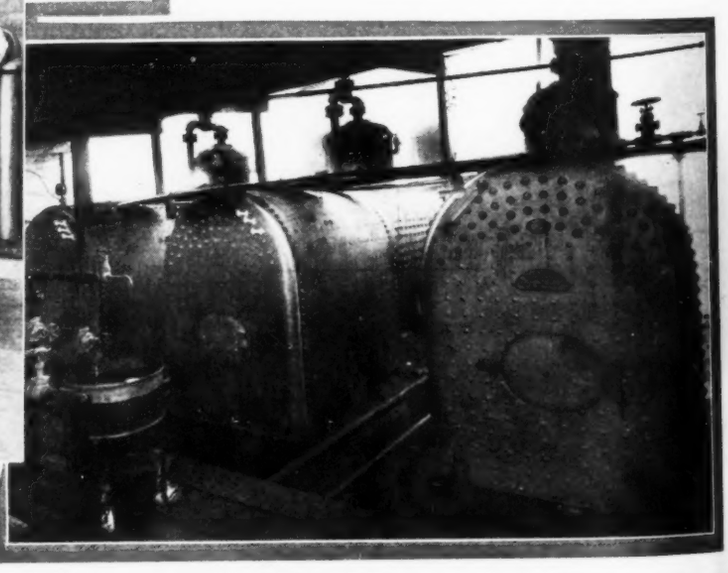
Petroleum Industry's

Trend Is Toward Heavier Material







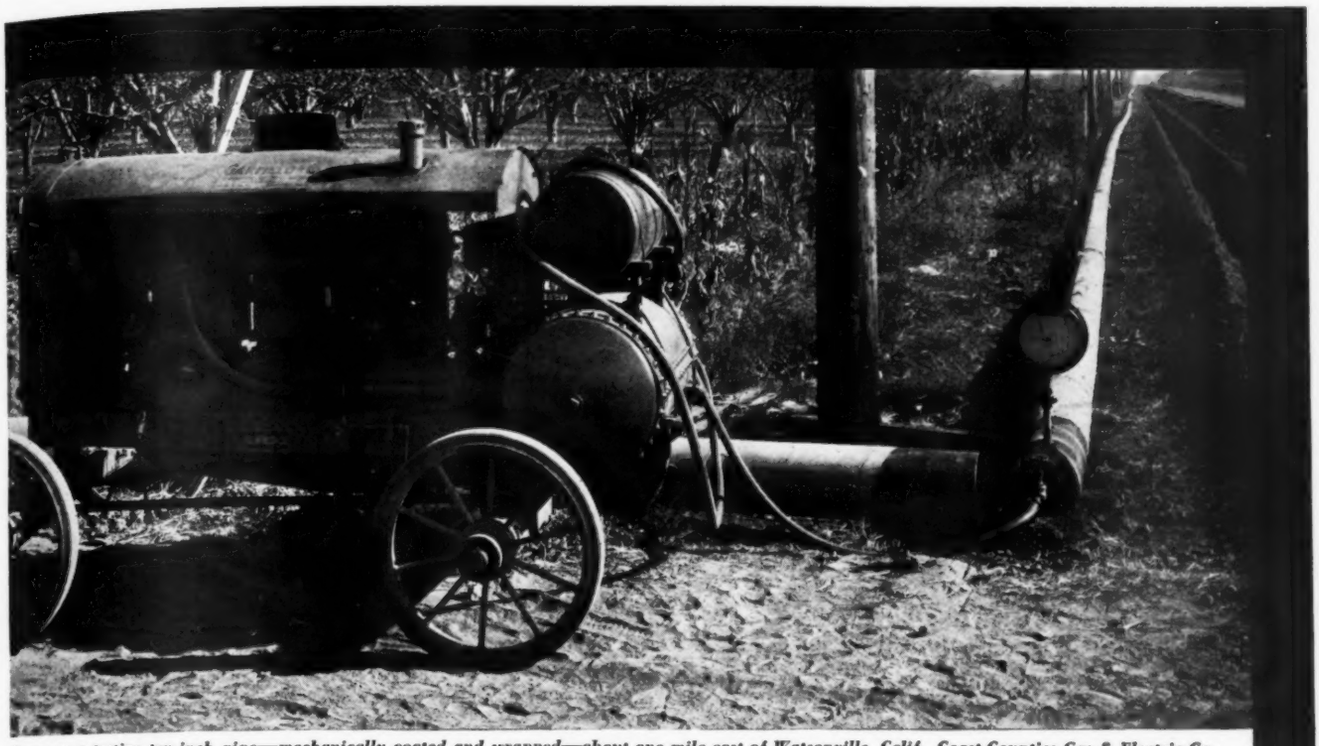
THE Oklahoma City field brought about the general introduction of extra heavy equipment to the Mid-Continent. The deep wells and high pressures encountered, coupled with the fast drilling pace established, brought along with them demands for heavier equipment and the latest methods of operation.

Because of the great pressures to be combated in drilling, big mud-hogs have been employed extensively and the tendency to use larger equipment has extended to pumps. A new Oil Well 15 by 7¾ by 20 pump is the addition in the pump field and is being set up for its initial run.

Three shaft draw-works and 12 by 12 drilling engines, along with six sheave crown blocks and five sheave traveling blocks, are common in the field. The use of the latter equipment is gaining a wider vogue as longer strings of pipe are handled. On one well 6,400 feet of nine-inch pipe was run close to the top of the producing horizon. A new and heavier type of swivel is to make its appearance soon.

At the present time much thought is concentrated on boilers, heat exchangers and condensers. A battery of 350-pound working pressure boilers, introduced by the Oil Well Supply Co., was recently installed. These boilers are equipped with a syphon, adding more heating surface to the fire box, and also have 2¼-inch tubes. The boilers incorporate many modern features of design, and contain 156 tubes to provide greater heat transmission. This type of boiler is available either with or without siphon.

Top to bottom—Shale separator at Oklahoma City, rotary table of Doheny-Stone drilling outfit, multiple cylinder engine on Doheny-Stone outfit. Lower right, battery of new 350 pounds working pressure Oil Well Supply Co. boilers used by Noble-Olson Drilling Co.



Compressor testing ten-inch pipe—mechanically coated and wrapped—about one mile east of Watsonville, Calif. Coast Counties Gas & Electric Co.

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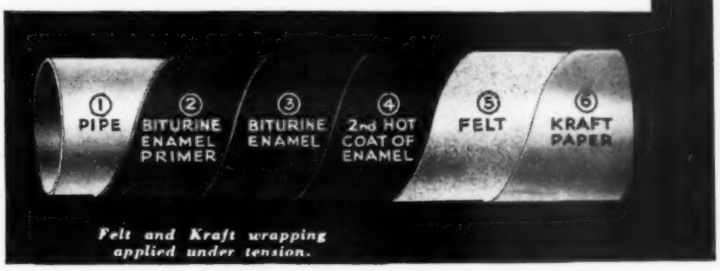

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Indiana Harbor, Ind.	Youngstown Sheet & Tube Co.
Lorain, Ohio	National Tube Co.
Milwaukee, Wis.	A. O. Smith Corp.
Youngstown, Ohio	Youngstown Sheet & Tube Co.

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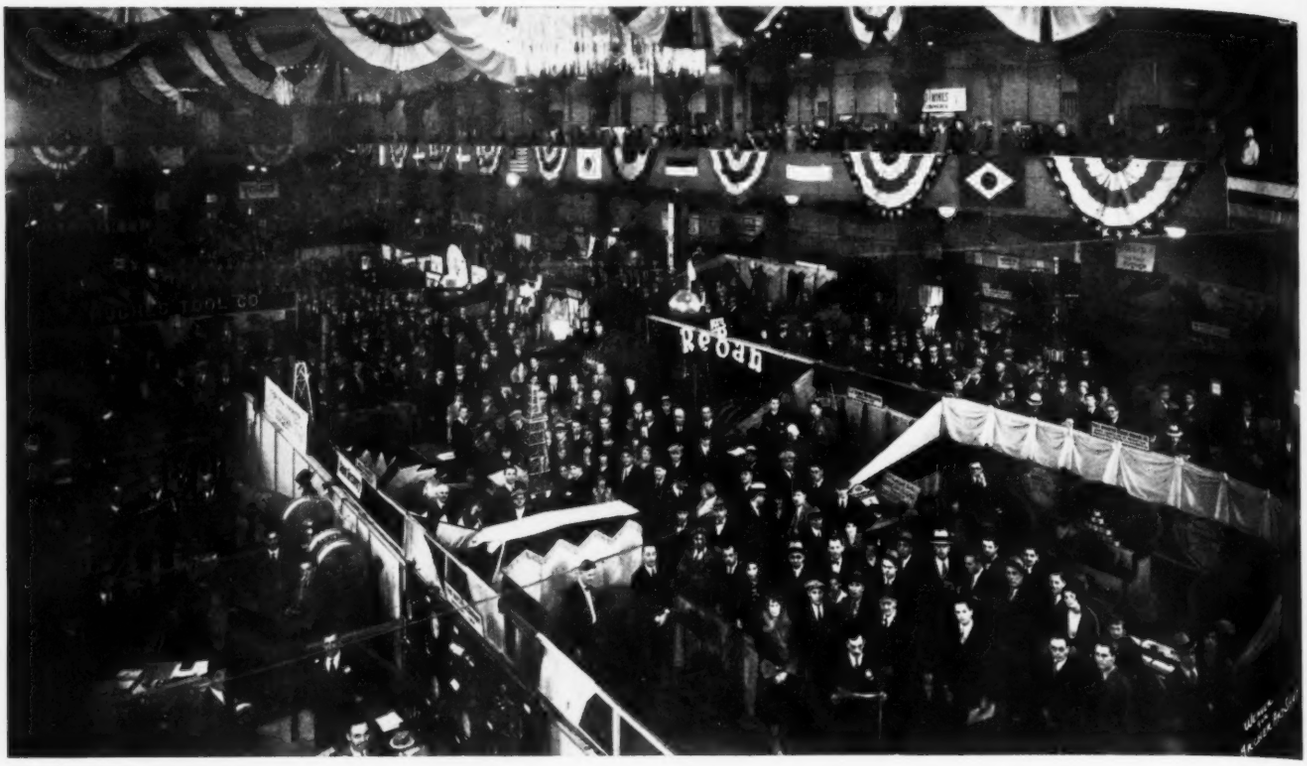


With Large Attendance and High Degree of Interest

California Oil Show Was Real Success

AFTER eight busy days, the Oil Equipment and Engineering Exposition in the Shrine Auditorium, Los Angeles, closed its doors on Sunday, March 23rd. Practically all space on two floors was occupied by exhibits that covered a wide range of interest and that represented an investment of millions of dollars.

Exhibitors were unanimous in expressing their approval of the management of the exposition and their satisfaction with the results they had obtained through contacts with the users of their products. Although many orders for future delivery of equipment were placed with the company salesmen at the various booths, the chief benefit of the exposition was the opportunity it gave to renew old friendships and to establish new business connections. Exhibitors are so well satisfied that, with few exceptions, they have already announced that they intend to increase the size and attractiveness of their exhibits next year.

Educational benefits to field men have been so evident to oil company executives that a larger attendance of men from outside districts is assured for the next exposition. This was the first opportunity that many of the visitors had had to attend an oil-equipment exposition and their comments on the tools and devices displayed showed that they fully appreciated the value of discussing their field problems with the makers of the equipment they were using.

Prize Exhibits

Representatives of the Advertising Club of Los Angeles, Bullocks Store, Sales Managers' Association, and Bay District Art Club formed a committee to award prizes to the exhibitors having the most attractive displays. They made the following awards:

First grand prize—blue ribbon: Axelson Manufacturing Co., Ltd.

Second grand prize—blue ribbon: Chapman Valve Co.

Divisional prizes for the most attractive displays were also awarded by this committee to Byron Jackson Co., for drilling equipment; Patterson Ballagh Corp., for small accessory display; Kobe, Inc., for machinery display; Kay Brunner Steel Products, Inc., for steel and electric art steel; Chapman Valve Co., for valve or pipe-line equipment; and to Axelson Manufacturing Co., Ltd., for production equipment.

The two-day conference of the production division of the American Petroleum Institute was the outstanding feature of the technical sessions held at the exposition. W. R. Boyd, executive vice-president, and Carl Young, secretary of the production division, were present and spoke briefly on the work of the institute.

A. H. Bell, general superintendent of the Continental Oil Co., was elected chairman of the California section of the A. P. I. for the current year. Three vice-chairmen to represent the important field districts were named to assist Mr. Bell. V. H. Wilhelm, chief production engineer of The Texas Co., will act for the Los Angeles Basin; A. H. Cranson, Honolulu Consolidated, for Ventura district; and A. L. Tietze, assistant general superintendent of Northern California district, Standard Oil Co., for the San Joaquin Valley.

E. W. Masters, chief production engineer of the Shell Oil Co., was elected secretary, and Lester Keim, vice-president and general manager of the Oil Well Supply Co., is the new treasurer.

The Second Annual Pacific Coast Oil and Equipment Exposition will be held in the new buildings from March 15 to 22, 1931.

Examination of

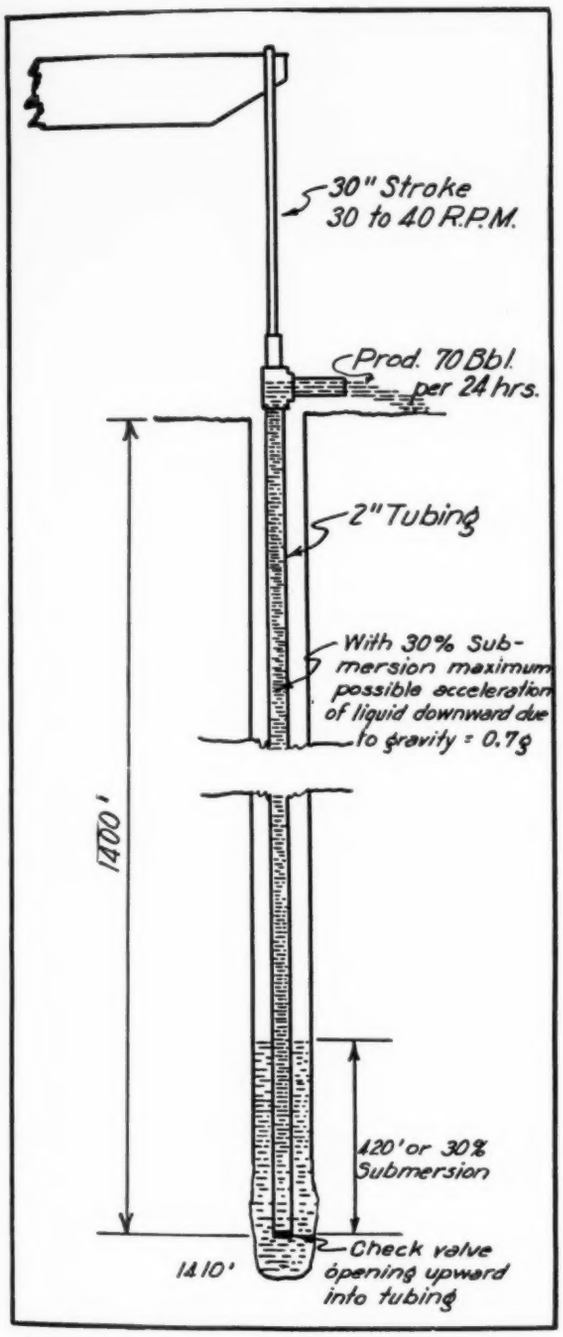
Rotary Drill Pipe Fluid Pressures

Reduces Trouble

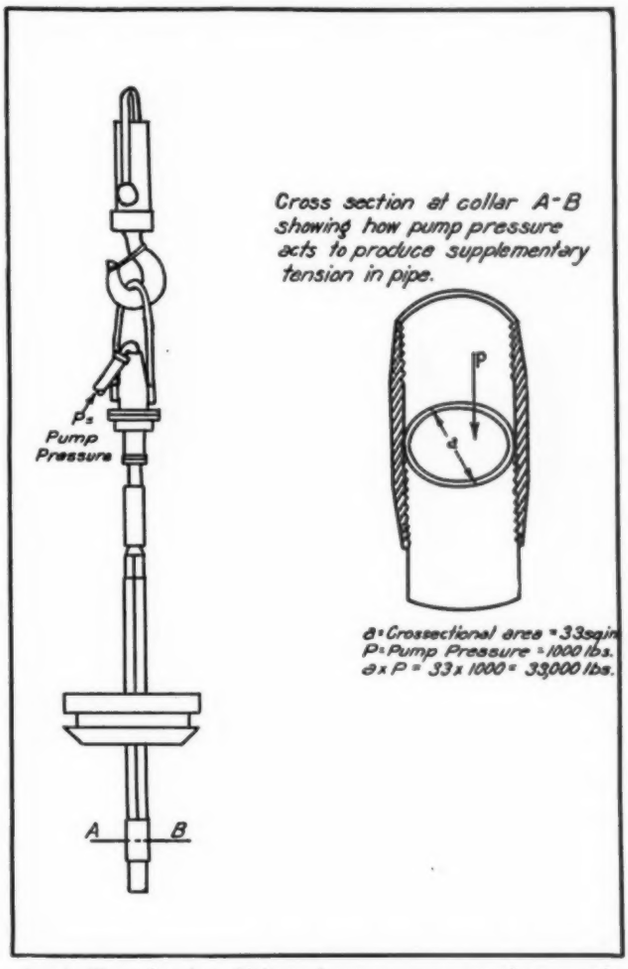
By J. T. HAYWARD,
Engineer, Shell Pet. Corp.

As drilled wells become deeper and deeper and the equipment more nearly perfect, further improvements depend upon intensive methods of research and matters previously considered of minor importance call for careful investigation and analysis. It is submitted that the fluid pressures met with in rotary drill pipe form a subject that would repay examination and discussion, and that they cause stresses in the drill pipe, couplings, etc., that are by no means to be disregarded. The writer has recently suggested that high pressures in the lower end of a string of drill pipe may prove to be very desirable, and to have an important bearing on the straightness of the holes drilled. On the other hand, high pressures are certainly to be avoided as far as possible at the upper end of the string. The dead weight loads, for instance, on the upper and most heavily stressed joints of a long string of 6⅝-inch pipe may be increased more than 30 per cent by the mud fluid pressure put up by the pump.

Five thousand feet of 25-pound pipe will weigh say, 107,000 pounds, the exact weight depending upon the density of the mud fluid, and this figure will be the total tension in the upper joints when the pipe is hanging on the hook and there is no slush pump pressure. The area of the cross section between the ends of the joints inside a 6⅝-inch



Arrangement to illustrate how in the rapid downward acceleration of 2-inch tubing in a well the liquid entered at bottom, gradually filling tubing to surface (1400 feet), although tubing had only 30 per cent submersion. This demonstrates hydraulic pressures that can be developed by rapid spudding of drill pipe.



Sketch illustrating how high mud pump pressure produces supplementary tension in top joint of drill pipe.

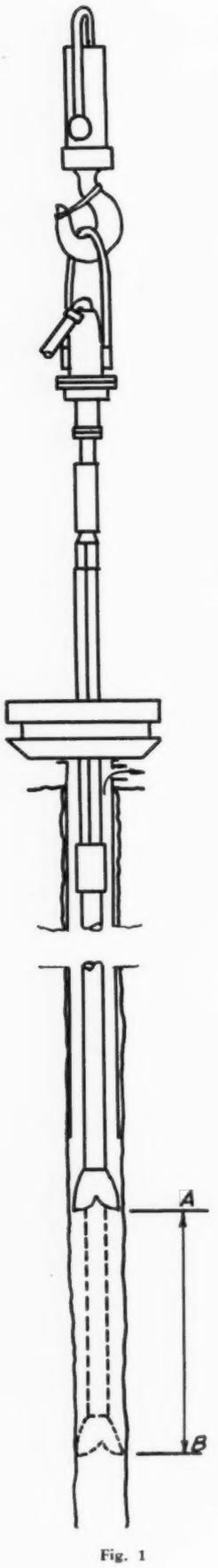


Fig. 1

When drill pipe is lowered rapidly, say from A to B, it is possible to build up pressures of 300 pounds per 1000 feet of drill pipe in hole with the following results:

1. No Float Valve. If no float valve is used on bottom of drill string the pressure built up is transmitted directly to the hose and mud pump at the surface. In a 5000-foot hole this may amount to 1500 pounds, which, with a pump pressure of 1000 pounds, would put a total pressure of 2500 pounds on the hose and pump.

2. With Float Valve. If a float valve is used on bottom of drill pipe, the pressure is built up below the float valve and tends to "corkscrew" the bottom part of the drill pipe. In addition, if the inside of drill pipe above the float valve is empty of fluid, the lower joints of drill pipe may be subjected to dangerously high pressures that are liable to cause collapse.

pipe collar is approximately 33 square inches. With a slush pump pressure of 1000 pounds per square inch there will be a supplementary tension due to the fluid pressure of 33,000 pounds which will increase the total tension in the joint by 31 per cent. One thousand pounds per square inch is a pressure that is not infrequently reached and exceeded with modern pumps and steam pressures in conjunction with a plugged bit or cave-in, and 900 pounds per square inch is regularly carried during drilling at some of the wells in Oklahoma City field.

Very large hydraulic pressures, due to inertia effects, may be developed in the drill pipe when this is lifted or lowered and during such operations as spudding, as the following experience illustrates: Some fifteen years ago a series of experiments were undertaken by the writer in an endeavor to overcome certain pumping troubles at a group of wells. Fourteen hundred feet of 2-inch tubing was run into an old hole 1410 feet deep and cased with 7-inch casing. Four hundred thirty feet of water was pumped into the casing, giving an immersion of 30 per cent. The tubing was open at the upper end and had a simple ball valve, opening inwards, fitted to the lower end. This string of tubing was hung on the beam and when started up functioned as a pump, filling up and overflowing at the top. With this lift of 980 feet, which was maintained by returning the liquid to the hole, 70 barrels per 24 hours were raised. The stroke and R. P. M. are not remembered with exactitude, but were probably 30 inches and between 30 and 40 R. P. M., and were lower than calculation indicated to be necessary to give the results. It will be understood that the 1400 feet of liquid in the tubing was counterbalanced to the extent of 30 per cent by the 420 feet of liquid in the hole. The maximum downward acceleration of the column of liquid in the tubing relative to earth was, therefore, 0.7 g. and whenever during the cycle the downward acceleration of the tubing exceeded this figure, liquid would enter the valve at the bottom and overflow at the top. This arrangement will not pump with oil or any gas cut fluid, being equivalent to a pump with a very high clearance-displacement ratio.

At a rotary drilling well with the holes in the bit open, and no float or check valve, the column of liquid in the drill pipe is completely balanced hydrostatically by the fluid in the hole and any acceleration in the liquid columns must be accomplished by change of pressure in the drill pipe. A rough calculation shows that this pressure, which is of course superimposed on the pump pressure, may, if the pipe is lowered rapidly, reach 300 pounds per square inch per 1000 feet of 6⅝-inch drill pipe. With 5000 feet of 6⅝-inch pipe, no float or back pressure valves, and pumps capable of putting up 1000 pounds per square inch, the pressure at the hose thus may reach 2500 pounds per square inch. Such pressures might be disastrous to either the hose or the pump and in order to avoid them it is customary to open the blow-off valve at the manifold when maneuvering the drill pipe.

In the case where a float valve is placed near the bottom of a string of pipe the rise in pressure will be concentrated at this valve and the pipe immediately above it will be put into compression. The same condition is met with when the bit is plugged and the compression in the pipe may in either case attain a value equivalent to one-third the total weight of the column of drill pipe. At the same time, the lower joints may be subjected to collapsing pressures amounting to one-half the static head corresponding to the depth of the well.

A float valve near the bottom of the string will not safeguard the hose and pump from excessive pressure when the fluid is gas-cut even to a slight extent.

The pressures and stresses dealt with above are all due to inertia effects and must not be confounded with the collapsing and compression loads to which the pipe is subject when running in with a float valve and the pipe dry. Under the latter conditions the pipe will be subject to a compression load at the valve equal to:

Weight fluid displaced by pipe above valve
Submerged weight pipe, bit, etc., below valve
and a collapsing pressure of:
½ (Depth valve below surface in feet) × lb. per sq. in. approx.

It appears to be the general rule in the Mid-Continent not to place float valves lower than 3000 feet, which for 25-pound pipe, gives a factor of safety against collapse, of a little over two under static conditions, which may be reduced to 1.60 when inertia effects are considered.

Increasing depths will probably direct efforts to decreasing the additional tension due to the fluid pressure in the already heavily stressed joints at the upper end of the string of drill pipe, and enable greater depths to be attained without increasing the total maximum loads on the joints.

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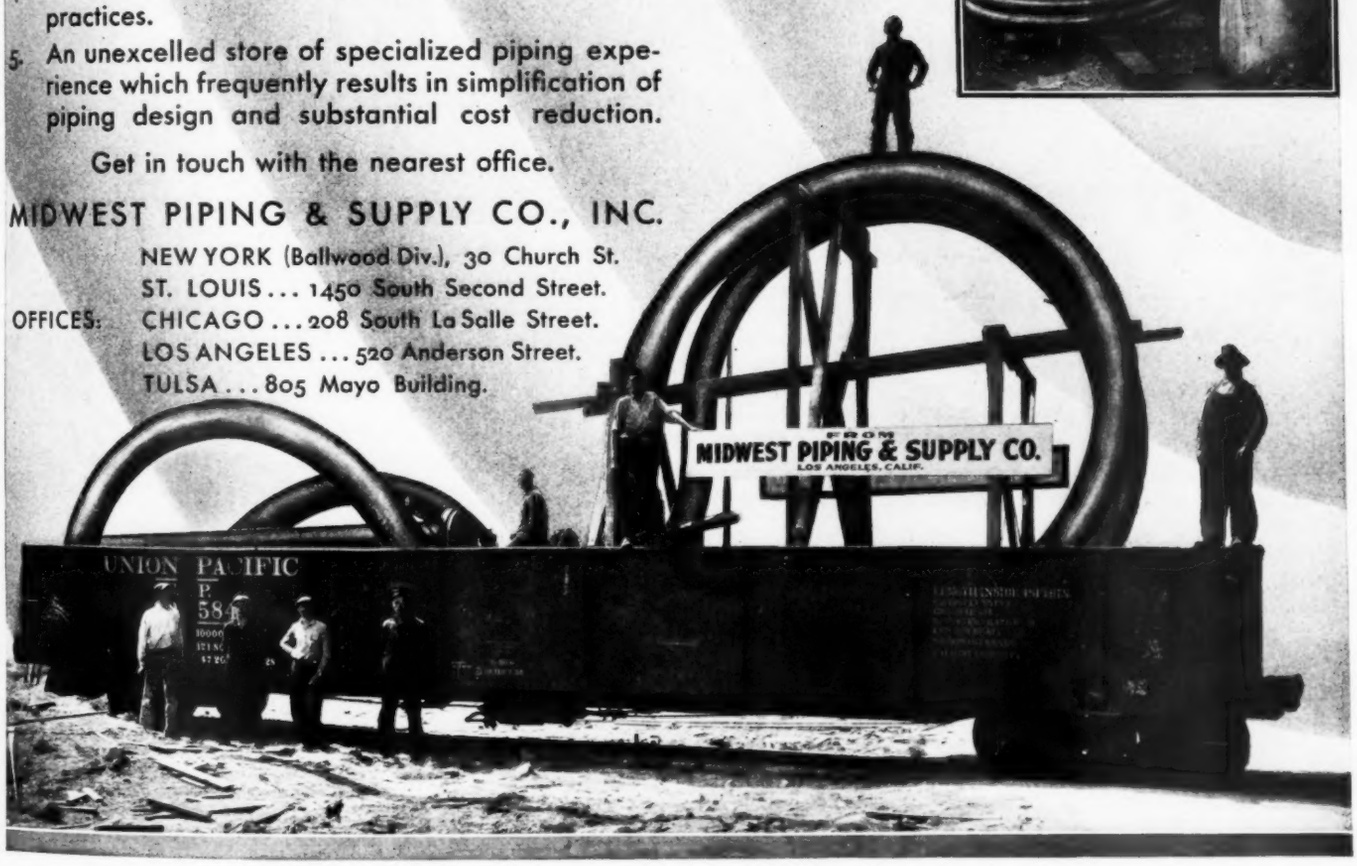

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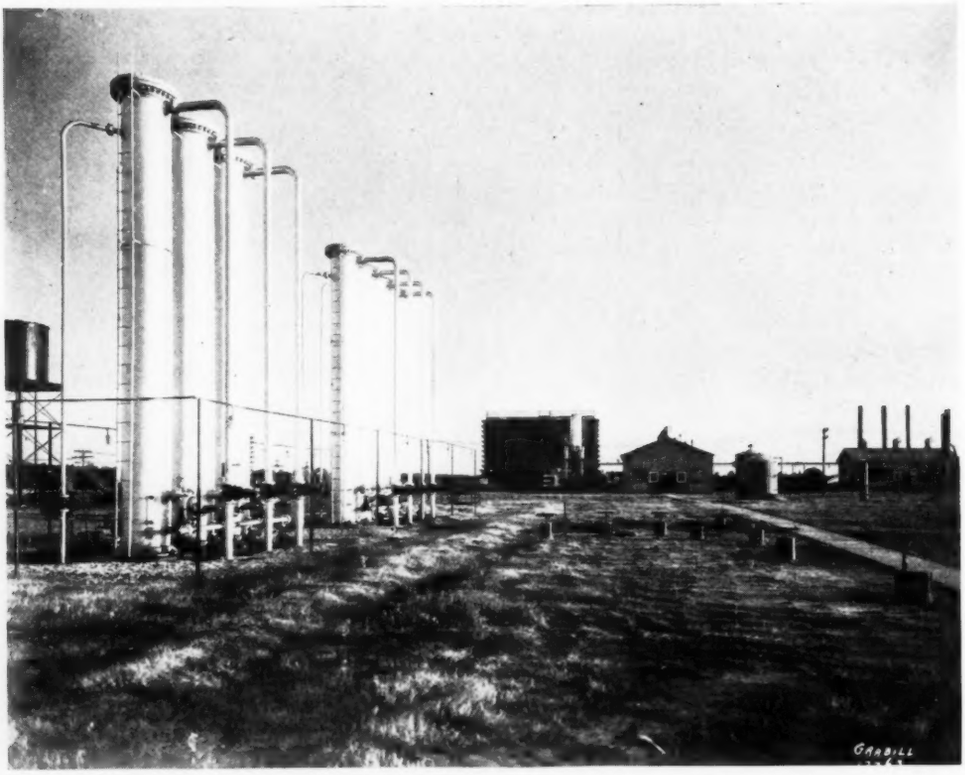
The Importance of Molecular Weights in the DESIGN *of* OIL ABSORPTION EQUIPMENT

By

F. L. KALLAM and L. J. COULTHURST[1]



Absorption towers, Magnolia gasoline plant, Sarepta, La.

THE recovery of natural gasoline from natural gas may be accomplished in a number of different ways, the predominating method being the absorption process. In this method the gas is washed or scrubbed with an oil whereby the desired hydrocarbons, such as butane, pentane, hexane and heavier fractions, are removed from the gas and become dissolved in the oil. It is then a relatively simple matter to remove the enriched oil to a distillation unit and recover the absorbed gasoline constituents, whereupon the denuded oil is again returned to the absorber for further enriching.

Unfortunately for this purpose, all natural gases contain methane, ethane and propane, which are undesirable constituents in natural gasoline, but which are also absorbed by the washing oil. Consequently, such of these undesirables in the resulting gasoline must be removed, and this is accomplished by a final fractional distillation which is known to the industry as rectification or stabilization. Under the present conditions, the rectified product may contain small percentages of iso-butane, but no fractions such as propane or lighter. This being the case, it would of course be ideal to absorb only the desired quantity of iso-butane and heavier hydrocarbons from the gas, producing a finished gasoline of the required vapor pressure without the necessity of rectification.

From a study of the physical laws governing absorption it is obvious that such selection by the absorbent oil is impossible. When enough oil is circulated and contacted with a particular natural gas to remove the desired quantity of normal butane, then the percentage of the iso-butane extracted is automatically fixed, as is the percentage of propane, ethane and methane. The greater the percentage of normal-butane extracted, the greater will be the percentage of each individual lighter hydrocarbon absorbed. At the present time it is safe to assume that a very economical operation is obtained if 50 per cent of the normal butane is removed from the gas, enough of this constituent being absorbed to assure (and this is extremely important) the removal of the hydrocarbons heavier than this fraction. In this way the amounts of iso-butane and lighter fractions absorbed which must be eventually discarded are kept to a minimum.

The smaller the percentage of normal-butane absorbed consistent with the desired finished product, the smaller will be the required oil rate. This means that fewer gallons of absorbent will be required per thousand cubic feet of the gas treated, and the lower

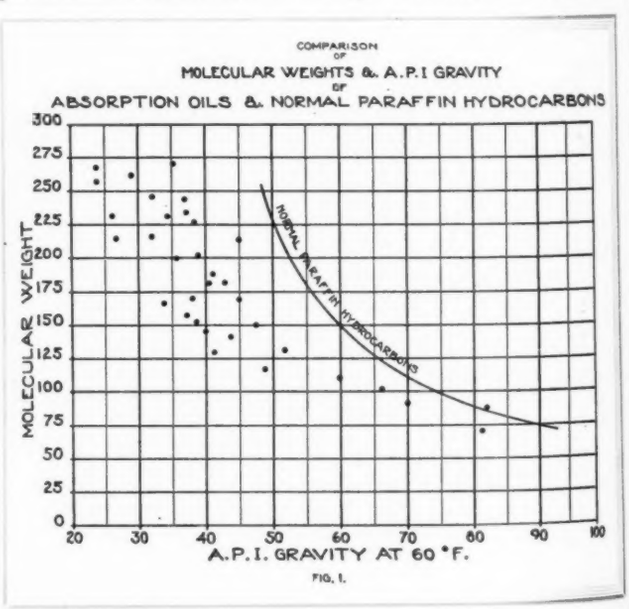


FIG. 1.

[1] Southwestern Engineering Corporation, Los Angeles, California.

this oil to gas ratio can be maintained, the greater the economy. This is evident since this ratio reflects directly upon the initial plant cost in that it controls the oil circulation rate which, in turn, governs the size of pumps, oil lines, heat exchangers, still and oil coolers. Further, operating charges are also directly affected by the oil circulation rate, since the lower this rate for the desired gasoline product, the greater return on the project.

The development of a satisfactory method for fractioning natural gas and gasoline into their component parts has reached a stage where it is possible to calculate with more or less success the oil-to-gas ratio required for various degrees of extraction in an absorption tower. Among other things, such calculations require a knowledge of the molecular weight of the absorbent used and such data are not available in the literature of the subject, although several methods for evaluating the molecular weight of a mixture of hydrocarbons have been suggested.

Methods of Correlation

One such method is to determine the average boiling point of the absorption oil. This can be readily accomplished once the boiling curve of the mixture has been ascertained. Knowing the average boiling point, use is made of the relationship between boiling point and molecular weight of the normal paraffin hydrocarbons by assuming that the molecular weight of the oil is that corresponding to an hypothetical pure hydrocarbon having a boiling point equal, or very nearly so, to the average boiling point of the oil.

Similarly, the second method utilizes the relationship existing between specific gravity and molecular weight of the pure hydrocarbons, making it only necessary to determine the specific gravity of the absorption oil in order to arrive at its molecular weight. Inasmuch as the oil-to-gas ratio required for a definite degree of absorption varies directly as the molecular weight of the absorbent used, other things being equal, it is apparent that the final result will be affected proportionately by the magnitude of the error involved in the molecular weight determination. For this reason it is necessary in the use of either of these two methods of molecular weight determination, to consider them in the category of pure approximations, and to consider the final results obtained in a similar light.

These methods of molecular weight determination must be classed as approximations because isomerism tends to prevent the linking of the molar weight with either the average boiling point or specific gravity of an absorbent oil. For instance, one of the five known hexanes has a specific gravity of 0.6583, while another has a gravity of 0.6701, the molecular weights, of course, being identical. The following table better illustrates how these methods could be poor approximations.

Constituent	Octane	Octylene	Cyclo-octane
Specific Gravity	0.702	0.722	0.850
A. P. I. Gravity	70.07	64.48	34.97
Molecular Weight.....	114	112	112

Thus by the addition of cyclo-compounds in particular, the A. P. I. gravity of an oil would be lowered, with the result that a high molecular weight would be obtained for the oil when estimating in this manner.

In Fig. 1 will be found a graphical plot of the relation between A. P. I. gravity and molecular weight for the normal paraffin hydrocarbons. This relationship is shown by the solid line. To this plot has been added actual molecular weight determinations made on typically used absorption mediums, and these values are represented by the dots. All such experimental values were obtained through use of the conventional freezing point lowering method, using benzene as a solvent, and then obtaining the final molecular weight value by graphical extrapolation to zero per cent concentration.

The lack of agreement between the molecular weight of the absorption oils and that of the normal hydrocarbons is self-evident from Fig. 1, the agreement being materially better with the lighter gravity hydrocarbon mixtures because of the presence of fewer components. In this region the mixtures more nearly approach the characteristics of the pure hydrocarbons, making the use of the method here somewhat more justifiable. In the range of the ordinary absorbents, however, such as oils from 30 to 40 A. P. I. gravity, the method introduces an error as high as 50 per cent in the molecular weights, the values so obtained being high in practically all cases.

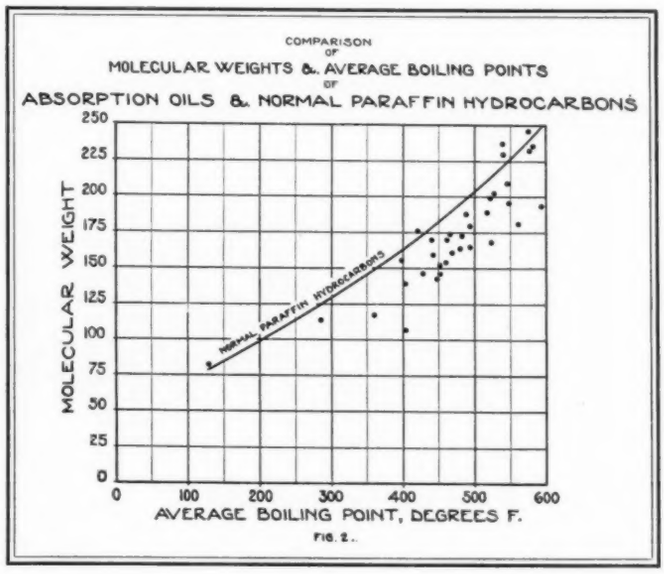


FIG. 2.

In Fig. 2 the molecular weights for the pure hydrocarbons are plotted against the corresponding boiling points, the resulting curve being shown by the solid line. The dots represent the experimentally determined molecular weights for various used absorption oils. It is quite obvious that attempts at determining the molecular weights of these oils from the data available on the pure hydrocarbons leads to considerable error. For the oils tested this error ranges from minus 6.6 per cent to plus 28.2 per cent, with 30 per cent of the values being plus 9 per cent higher than the determined molecular weights.

Just why it is unreasonable to expect to establish a definite relationship between the average boiling point and molecular weight of an absorption oil can be illustrated by the following example. The physical properties of isomeric compounds preclude this correlation, for the nearer a side chain is to the terminal carbon atom, the more the boiling point is lowered, i. e.:

Normal Octane— $CH_3\text{-}(CH_2)_6\text{-}CH_3$ B. P. = 125.8 deg. C.

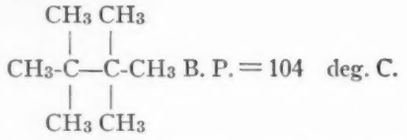
2-Methyl Heptane—

$$CH_3\text{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{-}(CH_2)_4\text{-}CH_3 \quad \text{B. P.} = 118 \text{ deg. C.}$$

2:5-Dimethyl Hexane—

$$CH_3\text{-}\underset{\displaystyle CH_3}{\underset{|}{CH_2}}\text{-}(CH_2)_2\text{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{-}CH_3 \quad \text{B. P.} = 109.2 \text{ deg. C.}$$

2:2′:3:3′—Tetramethyl Butane—



B. P. = 104 deg. C.

Therefore, a substance having a molecular weight of an octane (114) could have a boiling range from 104 to 125.8 deg. C.

In determining the molecular weights of various oils by means of the cryolitic method using dilute solutions, it has been found that the molecular weight increases with the concentration of the solution employed in the determination. Plotting these molecular weights against the corresponding concentrations results in a curve which fortunately has been found to be practically a straight line for the concentrations below 1½ per cent. As the laws of osmotic pressure hold only for very dilute solutions, it is possible to determine the molecular weight for the case of infinite dilution by extrapolation of this straight line back to zero concentration. This straight line is determined from three experimental determinations, using concentrations covering the range of 0.5 to 1.5 per cent by weight of oil in benzene. As it is, of course, impossible to make these three determinations without some error, and because of the fact that the straight line theory cannot be strictly correct for all cases, the molecular weights determined through extrapolation have been termed the "apparent molecular weights." It is these values which are plotted in Figs. 1 and 2.

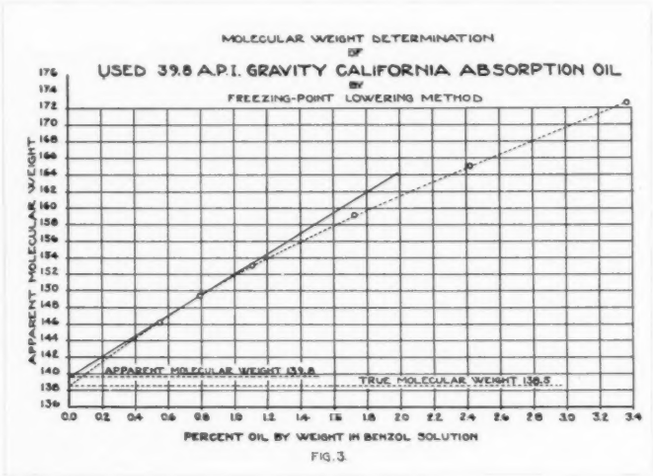


FIG. 3.

This concept that molecular weights of absorption oils are affected by the concentration of the solution from which they are determined is not in accord with the recent literature on the subject. In Fig. 3 is presented a typical determination made on a used California absorption oil having an A. P. I. gravity of 39.8 deg. The experimental points shown in this figure represent actual laboratory determinations made at these various concentrations. As it is practically impossible to obtain reliable check results on concentrations below 0.5 per cent, the dotted line has been drawn through these lower regions by estimation from the remainder of the curve experimentally determined.

For the purpose of argument, had it been possible to actually determine the lower portion of this curve, the true molecular weight would be 138.5. By using this suggested "three-point" method, the apparent molecular weight was actually found to be 139.8, which is sufficiently accurate for all practical purposes.

Had these same data been handled by the "averaging" method, so often suggested in literature, an entirely erroneous molecular weight would have been obtained. With this method, the four highest molecular weights corresponding to the four highest concentration points in Fig. 3, namely, 1.11, 1.66, 2.42 and 3.36 per cent, would have been averaged, with a resulting molecular weight of 162.5. Such a result is 16.2 per cent higher than that obtained by the "three-point" method, which itself is only slightly higher than the true molecular weight of the oil.

Influence of Molecular Weight of Absorbent Upon Design and Operation

That the molecular weight value of the absorbent influences not only the initial design of the absorber and distillation unit, but also eventually their operating efficiencies, is perhaps best illustrated by the following example. The conditions given for the design of this unit were that the absorber was to process three million cubic feet of natural gas per day, operating at 45-lb. absolute pressure, removing 50 per cent of the normal-butane content of the gas. It was also specified that the oil available would have a molecular weight of 144 and a temperature of 74 deg. F. Upon this basis and the assumption that the temperature of the oil leaving the absorber would not exceed 100 deg., the required oil-to-gas ratio was calculated to be 32 gal. per 1,000 cu. ft. of gas treated, or a total oil rate of 96,000 g. p. d. This latter figure was accordingly used for selecting pump sizes, line sizes, etc.

After the plant was completed it was found necessary to commence operations with an oil of 275 molecular weight and, inasmuch as the installed pump capacity was limited to a circulation of 100,000 g. p. d., the extraction of normal-butane was 28.8 per cent instead of the required 50 per cent. To obtain a 50 per cent extraction, the oil-to-gas ratio for 275 molecular weight oil is 57.8, whereas it was impossible to exceed a ratio of 33.3 gal. with the plant equipment. Later, satisfactory extraction was obtained by using an oil of 150 molecular weight with no other changes within the plant other than this change of absorbent.

Conclusions

The molecular weight of an absorption oil can only be obtained accurately by making a separate determination upon each oil under consideration. This is due to the great number and variety of compounds making up the present-day absorbents, which precludes correlating the molecular weight against some other physical property of the oil, such as gravity or boiling point. The cryolitic method of making molecular weight determinations is suitably adequate, and, when used in connection with graphical interpretation where extrapolation to zero concentration is carried out, results are obtainable which are reliable within 2 or 3 per cent of the true molecular weight value.

Arkansas Natural Announces $1,000,000 Plan

THE expenditure of $1,000,000 by the Arkansas Natural Gas Corporation and its subsidiary organizations was announced recently by D. W. Harris, Shreveport, vice-president and general manager. This development program will include the establishment of gas distribution systems in Nashville, Mineral Springs, Washington, Warren, Monticello, Wilmer, Stuttgart and three other of the smaller cities of Arkansas.

The establishment of these systems will cost approximately $500,000, while a like sum is being spent by the Arkansas-Louisiana Pipe Line Company, a subsidiary of the Arkansas Natural Gas Corporation, on pipe lines into these cities.

Methods Used to Reclaim

Marketable Oil in Tank Bottoms

ABOUT 12 years ago the first concentrated efforts were made to reclaim oil in large tank bottoms with the view to defraying a large percentage of the cost of making otherwise dead storage space in the tank available, as well as reclaiming at least a part of the oil in the b. s. Cleaning tank bottoms has always been a source of trouble and, since the above-mentioned time, considerable thought has been given to the subject.

During those years the methods employed have alternated among centrifugal processes, chemical treating, with distillation processes and acid treating methods sandwiched in between. With these methods the owners of stored crude at the present time are very well satisfied if they can break even on the cost of reclaiming the oil in the tank bottoms.

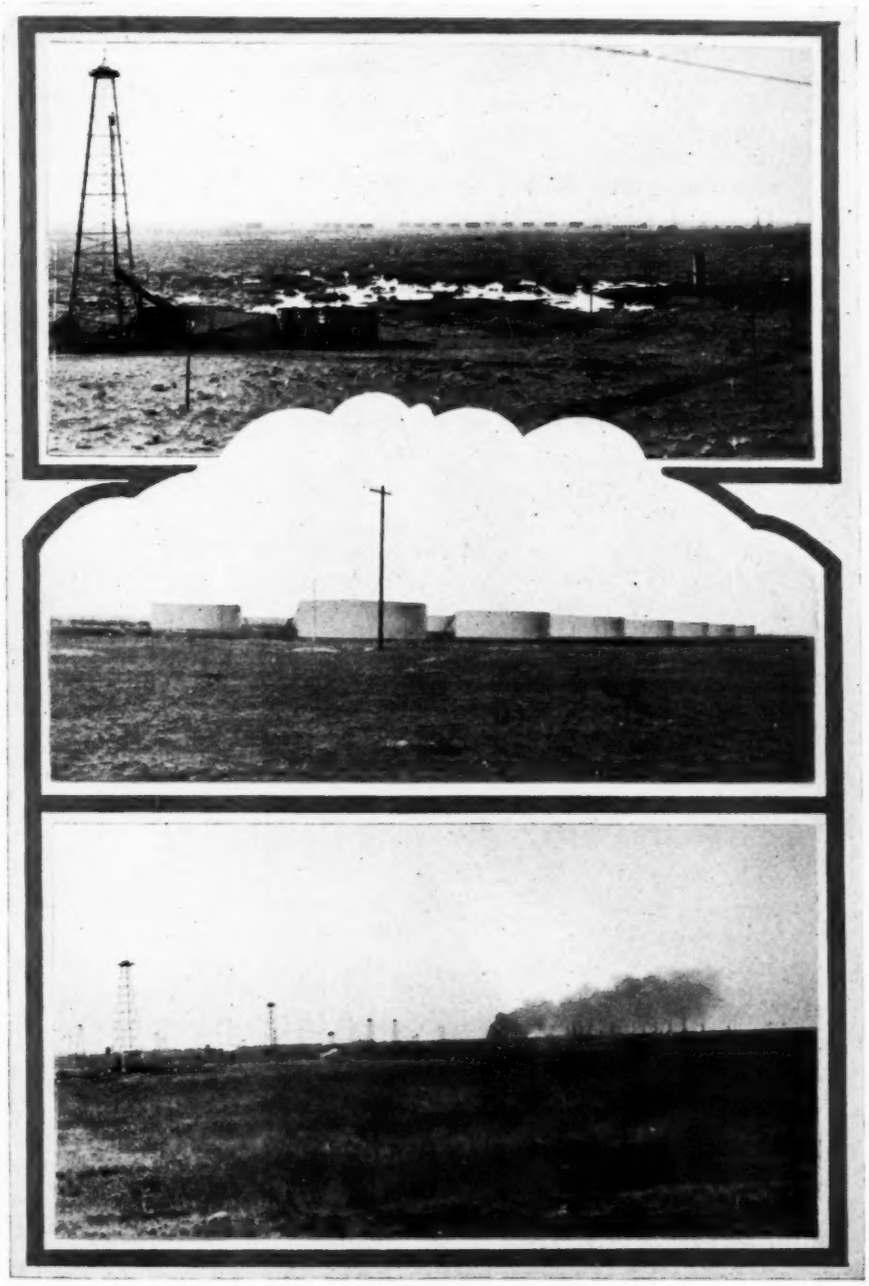
There has been relatively little work done recently in this direction and, in consideration of the accumulation of stored crude with the accompanying accumulation of b. s. in the tank bottoms, many owners of storage are now planning for the summer clean-up. The program will extend to West Texas, also, where tank farms are comparatively new.

The tendency of most companies seems to lean toward having the work done by contractors engaged in this particular line of work. Rather than go to the expense of forming an organization for such work, conducting research work to determine the best methods, invest in the equipment to operate the plants and be burdened with the attendant grief of such plant operation, these companies favor letting the work to contractors who are suitably equipped and organized to handle the problem.

Some new plants being designed for operation this summer will use chemicals or acid sludge for the reagent. Both are relatively new in this phase of treating and the chemicals are the more recent of the two. Acids have been used for a few years and have given satisfactory results as a whole, although in some instances they did not measure up to expectations when used on tank bottom b. s., which proved difficult to handle.

The first use of the acid method was in the Mid-Continent about three years ago. White oil sludge, a naphthenic base oil such as coastal crude, Russian crude and some California oils, was found to be a satisfactory reagent. The sludge was then purchased from Atlantic seaboard refineries.

With its use an excellent recovery of the marketable oil in the b. s. was possible. However, treating costs remained virtually the same as those with other methods, and an elaborate layout was required for a



Two West Texas tank farms, and below, burning b. s. ponds.

plant to use this method of reclamation.

The b. s. is picked up from the b. s. pit or tank through a 4-inch line with a 10 by 4½ by 10 pump and delivered through a 3-inch line to treating tanks. The treating tanks, usually 1,600-barrel capacity, are made of wood because the acid is too destructive to steel. The b. s. in the wood tanks is heated by direct contact with live steam to bring the temperature up to 180 degrees.

Steam is shot up through the b. s. with a spider four feet six inches off the bottom of the tank. The steam line enters the top of the tank, goes down through the center to the spider, which is 1-inch perforated pipe. When the proper temperature is being brought up, the acid is churned into the b. s. by the raw steam. Steam is supplied by three 45-horsepower boilers.

The acid is mixed in a lead-lined wood box. Its capacity is approximately 12 barrels. It is pumped into the treating tanks with a 6 by 4 by 6 pump. Because of the extremely corrosive nature of the acid, all of the steel parts of the pumps are usually replaced with brass parts.

After the acid has mixed with the b. s. and settled out the water and b. s., the clean oil is drawn out and pumped to clean oil storage with a 7 by 3 by 8 pump. A lateral line running from the boiler fuel tank to the clean oil line draws off the oil required for fuel. The water and some of the dirt is drained into the residue pond and is used to mix up the acid batch.

As much as 12 drums of the sludge have been used for treating one batch of b. s., but batches have been treated with as low as four barrels. This depends greatly on the skill of the operator of the plant, his frequent sampling of the emulsion and care exercised in the control of temperatures.

Treating with chemicals will require a layout similar to that used for treating with acid sludge. The treating tanks will probably be steel, vapor-proof, 1,500-barrel capacity tanks instead of the 1,600-barrel wood tanks. The pump for handling the chemical need not have brass parts, but in general the operation will be almost identical.

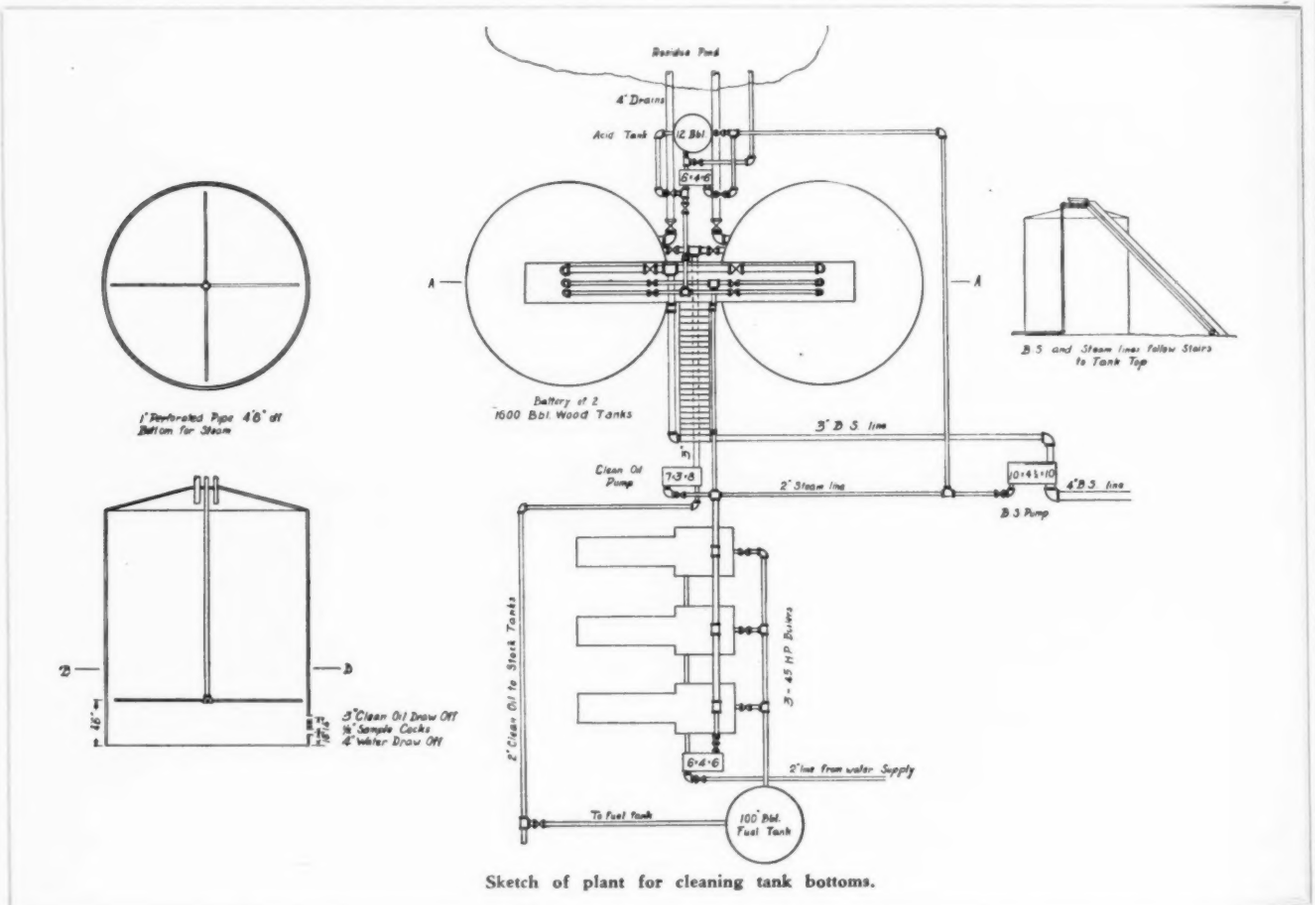
Some companies are planning to continue the use of their centrifugal batteries. Such machines were introduced to this type of work back in 1918 by the Prairie Oil & Gas Co. after considerable experimentation with them.

Generally these installations are steam turbine type centrifugal machines which require six boiler horsepower to drive the turbine. Each battery consists of 10 to 20 machines, depending upon the amount of b. s. to be handled. Each centrifuge has a maximum daily capacity of around 100 barrels of finished oil when operated on a 24-hour day basis, which is the usual operation for the larger batteries.

On most of the hook-ups for this method the b. s. is picked up from an accumulating tank or pump by a 10 by 4½ by 10 pump and discharged through a 4-inch line into the bottoms of 1,000 to 1,500-barrel treating tanks. The tanks are steel vapor-proof containers which are equipped with steam coils. A six-foot level of salt water is pumped into the bottom of the tanks and the b. s. gravitates up through the salt water as it is heated to a temperature of 180 degrees.

The temperature is controlled by means of a temperature regulator on the steam line feeding coils. After heating the b. s. to the required temperature the hot emulsion gravitates to the centrifugal machine battery. The centrifugal force developed by the machines throws out all of the water and b. s. The clean oil, containing less than 1 per cent b. s. and water, is picked up by a 7 by 3 by 8 pump and discharged to a receiving tank for gauging and delivery to the pipe lines.

Many interested in this phase of work expect the coming year's developments not only to eliminate much loss, but also see a slight reduction in cleaning costs.



Sketch of plant for cleaning tank bottoms.

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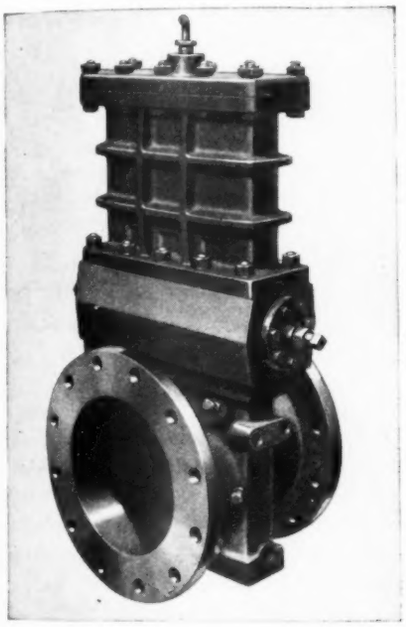
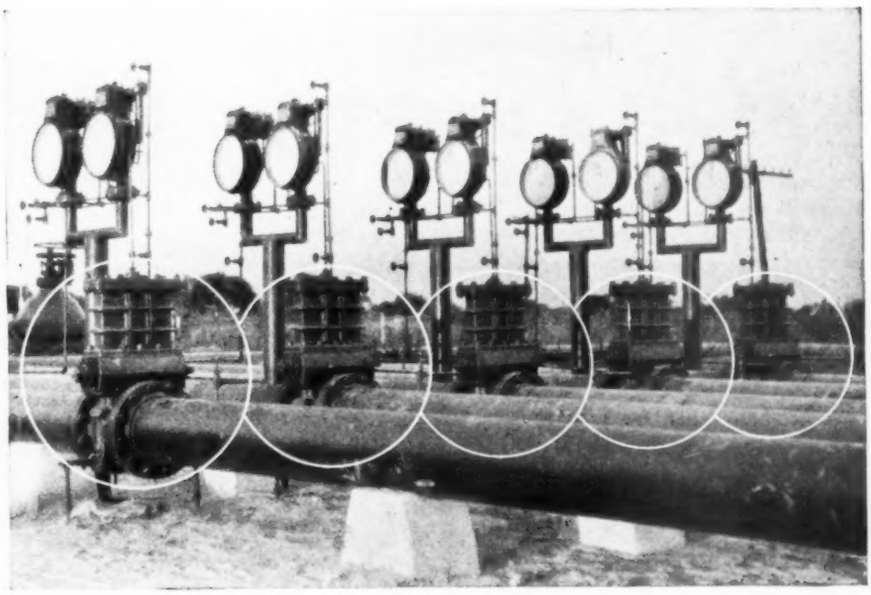
On gas, oil field and refinery pipelines, Robinson Orifice Fittings have three essential functions — they offer the most simplified and inexpensive method of changing orifice meter plates; they are the most compact method of housing the equipment; they produce the most accurate of metering. The remarkable ease and economy of installation is made possible by the elimination of the cumbersome and expensive by-pass. Accuracy in measurement is assured because the orifice is always centered and the flow must pass through and be measured. There is no by-pass valve to stick open — nothing to get out of order. Even plate changes are made with little or no loss or waste and no hazard.



Above, the complete fitting ready for installation. Note compactness and simplicity.

Ten-inch Robinson Fittings, at the right, installed by The Southern Gas Company, San Antonio, Texas.

The entire fitting occupies no more space than an ordinary gate valve and can be mounted in almost any position. It effects big material savings by eliminating valves, tees, ells, couplings, flanges, pipe, etc. One man can haul the complete setup in a small car, install it without help in short order. One can remove the plate for frequent inspection, micrometer checking or replacement—3 to 15 minutes is all it takes. Because it produces the most accurate metering at the lowest cost, Robinson is serving today in nearly 12,000 installations!



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Novel Equipment Used for

Examining Rocky Mountain District Wells

By F. BRAVITY EMERY

IN this advanced age of civilization we still have one development in the oil industry in a primitive area in the United States. Up in the Wyoming plains and mountain ranges, where big game areas still exist and

Typical well site.

where great elk herds numbering many thousands still range their native habitat, necessity, brought about by the primitive, mothers many inventions and short cuts to forward the work of drilling for and producing oil. Oil is being found both down in the deserts, in the plains country and well up in the foothills of the great mountain ranges, and some interesting makeshifts and new methods have emanated from Wyoming in the past few years that are of interest to the oil industry as a whole.

Wyoming has established a systematic supervision of field development and maintains an inspection service to prevent water intrusion in the various sands, and, in general, to recommend the more efficient methods of field operations for the betterment of the industry in the State.

All oil development on state-owned or patented lands in Wyoming is under the supervision of the State Geological Department and the State Oil and Gas Inspector. The State Inspector's offices are located at Casper, while the State Geologist's offices are in the capitol at Cheyenne. Casper is centrally located, so that any field of the state can be reached in a single day's drive, which would not be possible from the capital.

One of the recent developments brought out for the use of the State Oil and Gas Inspector of Wyoming is an instrument termed a deep-well thief. This is an ingenious affair that is hung on the end of a measuring line and which will give the measurement of the top of the fluid, amount of oil, amount of water, depth of the hole and pick up and bring to the surface a sample of the bottom of the hole, in one run. Its manipulation is comparatively simple. The power to operate it is furnished by an automobile.

In many fields and wildcat territory, wells stand idle while their future status is being determined. At times these wells are considered too small to be produced, yet there is a difference of opinion on this point; many other reasons could be cited why such wells are not plugged and abandoned at once. Very often some definite information is desired in regard to these old holes and this new deep-well thief of the Wyoming Oil and Gas Inspector fills the need.

It is customary to remove the equipment from such wells for use in other locations, leaving only the casing sticking

Cathead and rope drive on car wheel.

up out of the ground for the inspector to work with. The cost of moving in a drilling machine merely to determine the condition of the hole would be almost prohibitive, but with the deep-well thief and pipe standard the same information can be obtained at a minimum of cost.

The equipment is carried in a chest on the running-board of the car. It consists of a pipe standard screwed to the casinghead at one of the side outlets, or, where there is no casinghead, a saddle with a two-inch outlet is clamped on the top of the casing. The standard is made up of ordinary two-inch pipe and fittings with a short piece of two-inch upset tubing in which a bushing has been welded at right

Two-inch pipe standard and measuring line reel ready to test old well. Reel carries 4,500 feet of line.

One and one-half ton truck hauling nine uniform 40 foot lengths of 16" Naylor Pipe

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But trucking, unloading and stringing wasn't the only economy on this 12" Naylor Line. The complete comparison of the cost figures on the two lines---including all costs from freight to "as laid in the ground"---showed a net saving of $2,064.74 per mile on Naylor Pipe.

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angles, to receive the shaft of the measuring line reel. A swing joint made up of a street ell and a regular ell permits the standard to be set up in any direction in relation

Deep well thief after a run, sample bottle with automatic cork is standing on casinghead

to the top of the hole. The only tools needed are a 24-inch pipe wrench and an ordinary monkey wrench.

After the standard is set up, the reel in place and the pulley fixed over the hole, the deep-well thief is attached with a short piece of rope in order to give the kick when bottom is reached. The thief itself provides the weight necessary for the lowering of the line. A special cathead is placed on the hub of the car, which has been driven into position, and the wheel jacked up to clear the ground. A piece of shooter's cord answers admirably for a belt and at the reel a special pulley wheel engages the reel in place of the handle. The handle and pulley can be exchanged on the reel with little trouble. By running the car in low gear, the power from the engine winds up the line without any labor on the part of the inspector.

The measuring line is run in the well in the usual manner with the operator handling the brake. The slackening of the line when the thief hits the top of the fluid column is readily noticeable and the lowering is stopped and this point measured on the line. The raising and lowering to determine this point also gives the sample bottle time to fill and the automatic cork to close same, thus enclosing a sample of the oil in the well if there is any. The subsequent lowering of the sample bottle in the thief to the bottom of the hole does not affect this sample of oil, although the amount of water column may be high.

After determining the height of the fluid column, the thief is then lowered on down the hole. When it enters the water column a second slackening of the line takes place, warning the operator of this point. In some cases, this is not readily determined and more runs must be made to determine the top of the water column. However, in most paraffine base oils, a paraffine plug forms at the top of the water which readily indicates to the operator the height of the water column.

As soon as the thief enters the water, the oil enclosed in the shell around the sample bottle is displaced by water and this sample of water is retained until the thief is brought to the surface. This sample of the water in the well is often needed in solving problems of underground currents and especially in the use of dyes to determine the flow of water under the surface.

On being lowered to the bottom of the hole, the kick of the line is used in the usual way to determine this point. The operator then raises and drops the thief until he considers that the steel edge has chipped off some of the bottom of the hole and has picked up some of the sample of the cuttings in the valve bottom of the thief. These samples furnish an indication of the condition of the well as they indicate any cave and any filling up from the old bottom of the well. The samples are examined microscopically and sometimes by chemical tests and comparisons made with known clean samples of the horizons in the well, thus a rather good idea of the present condition of the well is obtained.

Practically every well in the state of Wyoming has its log on record, either with the United States Geological Survey or with the State Geological Department, and it is therefore relatively an easy matter for the operator to compare the findings of the deep-well thief with the record and history of the hole. Cases of split casing can be determined through the microscopic examination of the sand brought up by the thief.

Pulley wheel on measuring line reel.

Car with wheel jacked up ready to wind in the measuring line.

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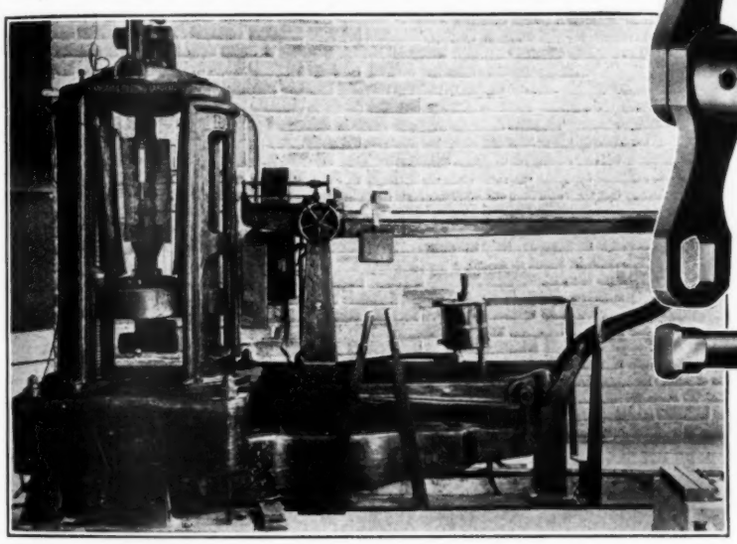

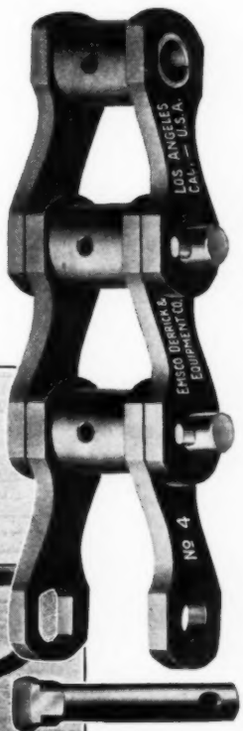

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How the Carbon Black Industry Succeeds in MAKING

By W. ANGUS

WITH companies originally operating solely as producers now expanding into complete organizations, even to marketing their own refined oil and gas products; with rubber manufacturers expanding into service station owners and operators; and with other oil organizations breaking into the public utility market, it is somewhat singular that carbon black manufacture has received such scant attention from the oil industry as a field for further investment and profit. It is a neglect not justified by any financial examination of the "black" industry. And natural gas, the agent from which all carbon black is made, is a petroliferous primary of the whole petroleum industry, of first economic importance, the object of intensive attack toward full attainment of its use, in its natural state and after it has been stripped. Much enlightened research technical work has been done on the gas in the last few years with profit to those tackling it in this spirit, but full use has not been made on many occasions of "tail" gas. Where the latter has been disposed of for fuel purposes, no higher economic handling could have been made of the commodity. But an active blow-off riser or torch is rank waste, which in many instances, has no reason for existing.

Failing disposal of natural and tail gas for public utility purposes, the manufacture of carbon black offers a solution and a profit for this gas being blown off into the atmosphere. While it is by no means denied that turning gas into black is making poor economic use of the gas, yet it must be admitted that even to extract "black" from the vapors is a sound advance from getting rid of them to the air. For that reason, then, this conversion is worthy of the consideration of the oil industry.

How big is the market for this commodity? In 1928 the total requirement was 253,000,000 pounds. In 1926 there were exported 39,210,389 pounds, and in 1927, 54,430,811 pounds, the latter increase being partly accounted for by the greater employment of "black" by European manufacturers in automobile tires. Last year still more "black" was consumed, but through over-production the price broke. In 1928 the average price was 6½ cents per pound. In the first two months of 1929, it brought 8 cents per pound in Texas and 8.1 cents per pound in Louisiana, but during November and December, 1929, the price fell to 6 cents and 6.1 cents, with a price range of 5 cents and 5.1 cents in Texas and Louisiana, respectively, during the first two months of 1930.

Carbon Manufacture Profitable

The price break was a misfortune common to both the oil and carbon black industry, but it is doubtful whether as a result, any "black" manufacturer had to delve into his capital reserves to relieve the strain. At the prices prevalent in the first two months of this year, he was still operating at a profit. This might be exemplified by consideration of a typical channel "black" plant, so called because the receptacle on which the "black" is deposited during manufacture is channel shaped. One such plant in the Panhandle district of Texas, consisting of 56 houses, each 14 feet by 140 feet, with a daily production of 20,000 pounds per day, cost approximately $168,000. Some estimated figures concerning manufacturing costs and sales returns follow:

Average overall cost of production per pound standard carbon	$	0.04
Market price (1928)		.06½
Profit per pound	$	.02½
Daily output, 20,000 lbs. @ $0.06½ per lb	$	1,300.00
Daily profit		500.00
Yearly profit		182,500.00
Investment		168,000.00
Profit on first year's run		14,500.00
Profit on remaining 4 years of 5-year permit at $182,000.00 per year		728,000.00
Less depreciation, average 10% of profits on 5 years' operation, with investment paid off on first 12 months' run		642,000.00

A Panoramic View Showing

PROFIT *from* "TAIL GAS"

ROSS

Still Low Efficiency

Carbon Black is put to a variety of uses by the industrial world, but by far the greatest demand comes from automobile tire manufacturers. Several years ago any kind of "black" served their purposes, with the result that the motoring public was running over rubber of all sorts and grades. Scientific investigation of just what "black" does to a tire changed the viewpoint of the tire makers until today they buy under only stringent specifications which cover such items as grit, color, grade, density, ash content, and resistance to abrasion. One of the largest rubber manufacturers has a research laboratory which has materially assisted in maintaining a constant quality in the carbon accepted, and consequential aiding in the maintenance of their own products. Carbon is included in the making of a tire with a limit of 9 per cent content, beyond which point carbon is harmful. A special kind of carbon, Thermatomic Black, is used in the sides of casings and has ousted Zinc Oxide for this purpose. The second largest use of "black" is for News Ink, with smaller markets for paints, varnishes and lacquers.

The methods of making "black" are varied, but all are basically the same, in that the gas must be burned under an insufficiency of oxygen, with the burnt gases allowed to strike against some slow moving surface. From this surface the "black" is scraped by mechanical scrapers into containers set in position to receive the carbon, whence it is transferred by conveyors to the packing house. The gas is burned through small tips, with the air consumed for slow combustion being regulated by manipulation of vents. Of the several processes in use, the channel type is the almost universally employed method of carbon making. Yet though the industry is over 40 years old, the methods of today are but little advanced on those of two score years ago, the efficiencies attained still distressingly low, and the waste very great. In the best of the channel plants, only 20 per cent of the "black" in the gas is extracted, the remainder going to the air to make those intense black smoke clouds, visible many miles from their source.

Success of New Process

Only one striking advance on known methods has transpired in late years, in which greater extraction has been made with its attendant higher efficiency. That is the process evolved, after six years' research and experiment, by the General Atlas Chemical Company, a subsidiary of the Cities Service Company, and demonstrated as a commercial success in the plant erected and operated at Pampa, Texas. There is no smoke screen issuing from this plant to mark the nature of the undertaking within the fence; only a little whitish colored vapors, mostly steam, emerging from the smoke stack. The whole of this factory occupies less than 10 per cent of the area of any typical channel process plant, a marked saving in site purchase, gathering and distributing lines, and general equipment. Because of the cleanliness of operation, this plant could be harbored within the confines of any city, whereas, the carbon depositing smoke of some of the other processes preclude them from the hospitality of any municipality.

The methods employed by the General Atlas Chemical Company have been patented, so that little can be written about them. Without, however, abusing their confidence, it can be said that they burn the gas in a large brick furnace of special design through a patented tip, with carefully controlled automatic air feed rate, thereby regulating the furnace temperature, an important phase in good carbon making. This burner has been devised after much trial and research, and used because it permits the free passage of the gas, remains cool, gives, with controlled oxygen feed, perfect combustion, does not choke up readily, and permits of the whole set of burners in one furnace being cleaned in 15 minutes and the unit being put back into operation within another 15 minutes.

After burning, the hot gases pass into a cooler, where the temperature is reduced by cold water in the form of

A carbon black plant in the Texas Panhandle.

a very fine spray, to a point where it is ensured that they will not rot the fabric of the screens through which the gases next pass. The screens or filters are made of a cotton fabric, the mesh of which is such that it will allow the more or less free passage of the gases from the inside of the screen to the outside, but will retain the carbon. At regular intervals mechanical beaters agitate the filters to remove the "black", which, in this method of manufacture, is of such a density that no artificial means need be taken to increase density. This type of carbon flows easily from the receiving hoppers into which the screens dump the product. Packed in double paper sacks, each of 25 pounds, the "black" is ready for the market.

The most marked advantage of this new process is found in the largely increased "black" production per 1000 cubic feet of gas passed. Whereas, the average output for the channel process is 1.5 pounds per 1000 cubic feet, that of a plant described above is several times this figure. This extraordinarily high yield puts this method in a financial class of profitable industries all by itself, and much better than its predecessors, although the latter pay well under current methods of operation. The main deterrent to 100 per cent success of this revolutionary method is that the grade produced is off-color, but it has been found practicable to use it in that direction where most carbon is absorbed, and that is in the making of rubber. It is claimed that rubber containing this "black" will cure faster, and show a higher aging capacity. Because of great density it is easily handled, and the low moisture content makes for uniform rubber mixing. In making rubber black, almost the whole problem is to maintain the same quality of the "black", and the new process has scored in this direction.

The normal channel plant employs:

	Per Hour
Black pourers	$0.55
Press men, piece work 60 sacks per hr. or 7500 pounds per 60 sacks	0.50
Repairmen	0.50
Warehousemen, who have responsibility of shipping the carbon	0.50-.75
Borger District, Texas output	M cu. ft. gas
Skellytown, Texas	1 lb.-1 1/3
Pampa District, Texas	1½ lb.
Stephens County	1½ lb.-1¾ lb.
W. Virginia, for special kind of lacquer black with small market	2 lb. and better 4/10 lb.

Careful Consideration Advised

Any newcomer seeking to enter this industry must face stern facts militating against any rashness in deciding to invest. Firstly, there confronts him the specter of last year's over-production. This arose partly through the Louisiana plants still operating in 1929, when it was thought that the Monroe Field gas production would have been diverted into trunk lines for distribution at distant points for industrial and domestic purposes. This would have deprived the carbon plants of their gas requirements, but slowness of the trunk lines in reaching their new markets has delayed the demise of the black industry of Monroe, where it has flourished for many years. There will doubtless be some marked improvement in keeping production this year closer to demand.

Another factor for consideration is that conversion of gas to carbon black is only permitted where there is absolutely no other and more economic market for the commodity, and at that, only stripped gas is permitted to be employed in this direction, therefore a gasoline plant is a necessary adjunct to any carbon factory. Then, too, the State of Texas, presently harboring the majority of such plants in this country, will give only a five years' permit, at the end of which time the fate of any black factory will be in the balance. With the demand for dry gas growing every day and being expressed in places far removed from the source of production, and with trunk lines being laid in answer to those demands, the day is not far distant when the higher income derived from the sale of gas for public utility purposes will divert much of the present supply going to the manufacture of carbon.

Advantageous Partnerships

Right now the partnership of a gasoline making company with a carbon concern is common in the Texas Panhandle and is an arrangement highly advantageous to both parties. It is the method recommended to any desirous of converting tail gas into money instead of blowing it into the air. The carbon maker has no desire to add gasoline manufacture to his present activities, while the gasoline manufacturer still less desires to get entangled with the intricacies of "black" production. This is the idea behind the Coltexe Carbon Company, union of the Columbia Carbon Company and The Texas Company, and the Texas Elf Carbon Company, union of the Cabot Carbon Company, and the Phillips Petroleum Company. The stripped gas is delivered by the gasoline manufacturer to the carbon plant, from which moment until the sale of the fabricated carbon f. o. b. plant, the operation is wholly that of the other partner. The division of the profits in such arrangements in the Panhandle is 70-80 per cent to the carbon black plant owners, and 30-20 per cent to the company furnishing the gas.

Co-operation with some well established carbon manufacturer makes for assurance of a market for the product, and furnishes the oil industry with another good reason for co-operation with the carbon industry rather than any direct effort to manufacture and sell carbon in face of established business.

From Waste to Profit

Assuming then, state permission to fabricate carbon, a lasting available supply of stripped gas, a lack of other markets for the combustible gaseous material, and a partnership with a sound carbon maker of reputation, there is every good reason for producers turning tail gas into cash. It is a matter that many companies could well investigate to their advantage, and is to be recommended on the score that the economies which can be effected in thus disposing of their gas will add to the well-being of any organization. And, as an aid toward reaching decisions, it should be borne in mind that the richer the original casinghead gas in gasoline content, the greater will be the yield of carbon black resulting from the combustion of the stripped gas.

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Ever stop to think that YOU are the COMPANY to those with whom you come in contact? Ever consider that what you do and say, how you treat others, creates a picture of the company you work for in the minds of those you serve?

The public's opinion of any company is formed chiefly from its contact with that company's employes. By their words and deeds, their service or lack of it, they can make or break their employer.

Efficient, happy employes create the impression of an efficient, trustworthy, successful company. Inefficient, surly employes paint a picture of an inefficient, despotic, crooked business.

Did it ever occur to you that it might have been the ice man who cursed the cook, kicked the dog, broke the refrigerator and left the doors open that made the iceless refrigerator popular? The surly conductor and touchy motorman who snarled at the patrons, dumped them into their seats and treated them as pests might have paved the way for the motor bus.

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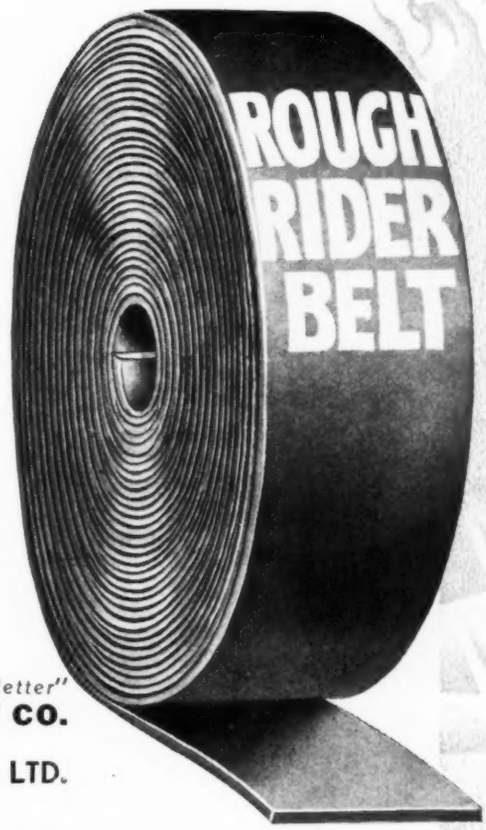

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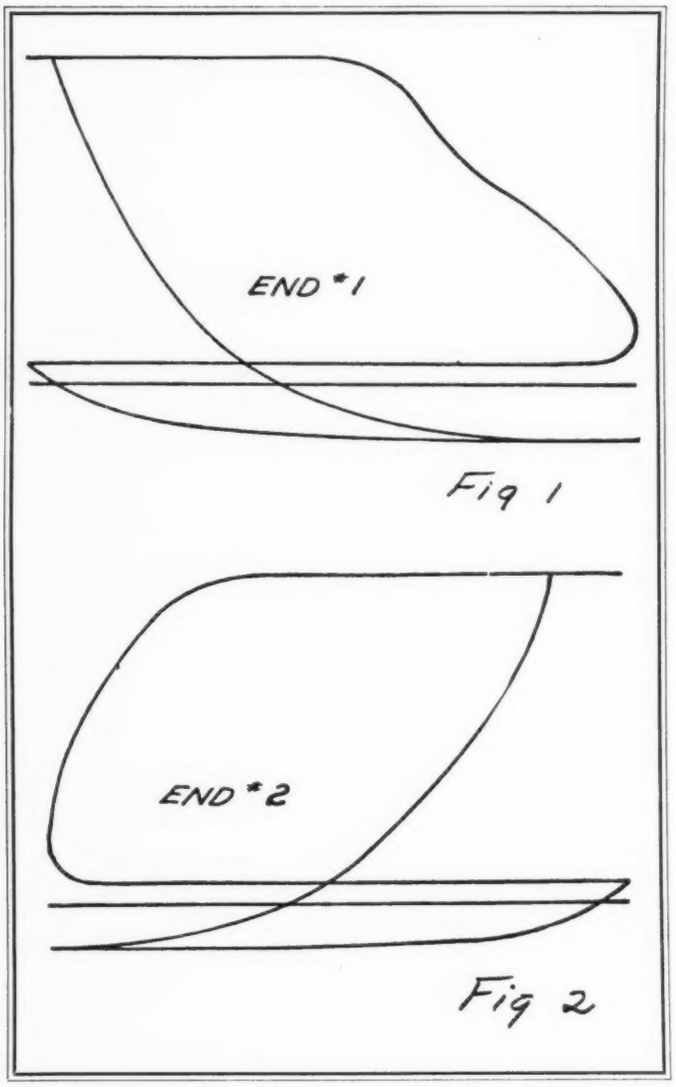
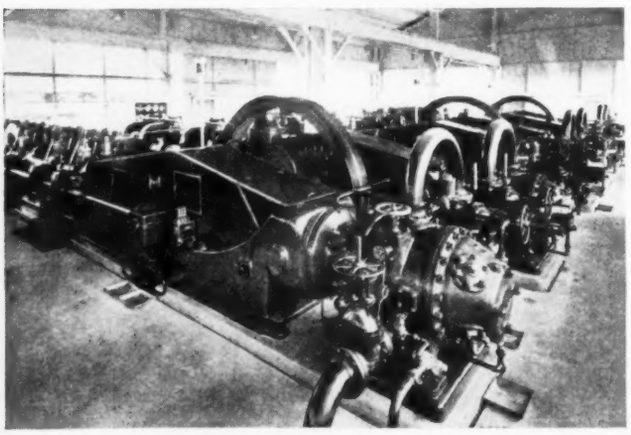




Compressor end of Magnolia Gas Company's station at Sarepta, La.

IN figures 1 and 2 are shown stop cards from No. 1 and No. 2 ends of a double-acting engine. The characteristics of the lines shown indicate that leakage from the cylinder is occurring, and as will be brought out later on, the valves are giving rise to most of the leakage. It is probably impossible to determine from the stop card whether the intake or exhaust valve is leaking or whether both are leaking because the effect on pressure in the cylinder is the same in all cases. However, if all the leakage in No. 1 end, as shown by the stop card, were occurring through the exhaust valve, it certainly should be determined by ear. The card from No. 1 end is a very bad case of leakage and may not be often encountered. It should be realized that the heavier the load on the engine, the more pronounced will be the effect on the stop card of leakage from the cylinder, and an engine with a very bad exhaust valve, running on a light road, may at times show a fairly good card.

To determine whether or not the piston rings are holding properly it is necessary to consider the order of events on each side of the piston and thereby take into account the possible effect of one side or the other. To facilitate the analysis of cards from double-acting engines, the sequence of events in a double-acting engine is given below:

No. 1 or No. 2 Ends	*No. 2 or No. 4 Ends*
Firing stroke	Compression stroke
Exhaust stroke	Firing stroke
Inlet stroke	Exhaust stroke
Compression stroke	Inlet stroke

Assume that No. 1 end is on the firing stroke. End No. 2 is on the compression stroke, and if the rings were allowing considerable leakage to the other side of the piston, the stop card from No. 2 would show a compression line rising very rapidly due to the pressure built up from the burning of the mixture on No. 1 side. This condition is not revealed to any extent by the stop card from No. 2 end.

Assume No. 1 end is on the exhaust stroke. End No. 2 is now on its firing stroke, and any appreciable leakage from No. 2 end past the rings would certainly be reflected in an increased exhaust pressure in No. 1 end. A comparison of the exhaust pressures of the two stop cards reveals practically no difference. (Since No. 1 end is on the inlet stroke while No. 2 is exhausting, there is no condition within the cylinder that could bring about an increase in exhaust pressure in No. 2 end.)

With No. 1 end on the compression stroke, No. 2 end is on the inlet stroke, and considerable leakage past the piston rings would show up by the intake line falling more closely to the atmospheric line on No. 2 end. While this condition may seem to exist to a small extent when comparison of the cards is made, it is not sufficiently pronounced to indicate severe leakage.

It should be remembered that there is no means of differentiating between inlet valve leakage and exhaust valve leakage through study of the stop card. The card will reveal leakage from the cylinder, but nothing more, and the loss may be through either or both of the valves. As stated before, severe leakage through the exhaust valve can usually be determined by ear.

Economies Effected in Pipe Line Machinery Lubrication

By H. A. WIENECKE*

IF one would make the statement to the average man interested in the operation of the oil industry that a yearly savings of $25,000.00 to $30,000.00 is being made annually by one major company in lubricating oil alone, he would be prone to disbelieve it. However, this is true and the climax is far from being reached. When you stop to consider that an annual expenditure for three major companies in the Mid-Continent field for lubricating oil reaches the vast total of $400,000.00, it is not hard to understand that such savings are being made and that more can be realized.

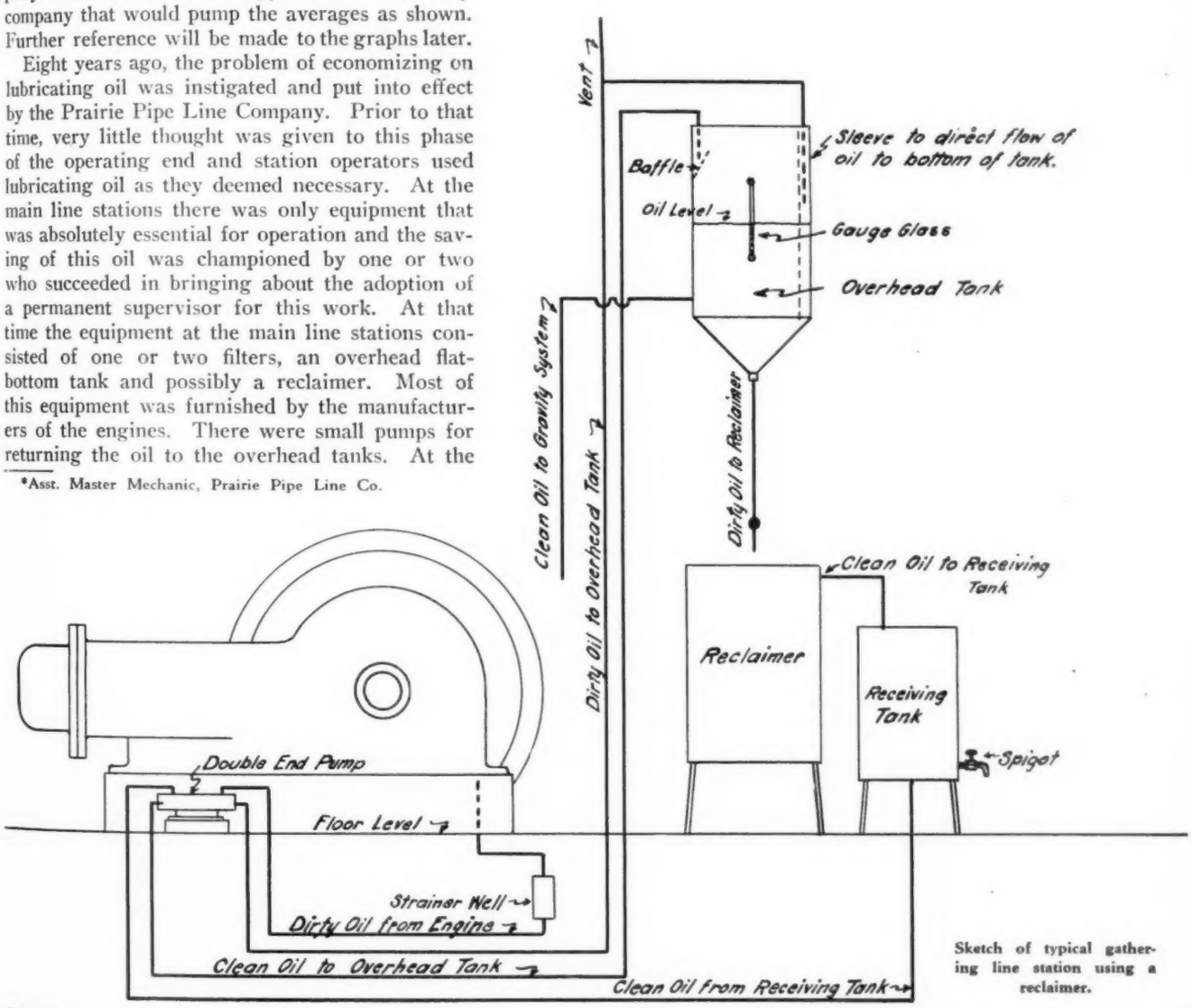
The basis of the above statement may be found in the graphs and data sheet which accompany this article. The graphs cover the period from 1922 to 1930 and give the average cost of lubricating oil used per one thousand barrels of crude oil pumped by the Prairie Pipe Line Company. The data sheet is a hypothetical case of any company that would pump the averages as shown. Further reference will be made to the graphs later.

Eight years ago, the problem of economizing on lubricating oil was instigated and put into effect by the Prairie Pipe Line Company. Prior to that time, very little thought was given to this phase of the operating end and station operators used lubricating oil as they deemed necessary. At the main line stations there was only equipment that was absolutely essential for operation and the saving of this oil was championed by one or two who succeeded in bringing about the adoption of a permanent supervisor for this work. At that time the equipment at the main line stations consisted of one or two filters, an overhead flat-bottom tank and possibly a reclaimer. Most of this equipment was furnished by the manufacturers of the engines. There were small pumps for returning the oil to the overhead tanks. At the gathering stations an occasional filter would be found. That this outlay was inadequate is borne out by the accompanying graphs.

With this as a basis, it was the problem of the mechanical department to evolve a system and install needed equipment to show an efficient operating cost. It was necessary to install efficient equipment to reclaim the oil so that this oil could be used again and again on the wrist pin, crank pin and main bearings of the engines and on all parts of the pumps. The cylinders and pistons of the engines are fed with new oil only. Also some system of reporting the oil used at each station was necessary so that a check could be made on these stations and their cost noted monthly.

I will not attempt to go into detail about the equipment that was furnished other than to say that the best possible was furnished those stations that warranted the expenditure and for the smaller gathering line stations, only necessary

*Asst. Master Mechanic, Prairie Pipe Line Co.



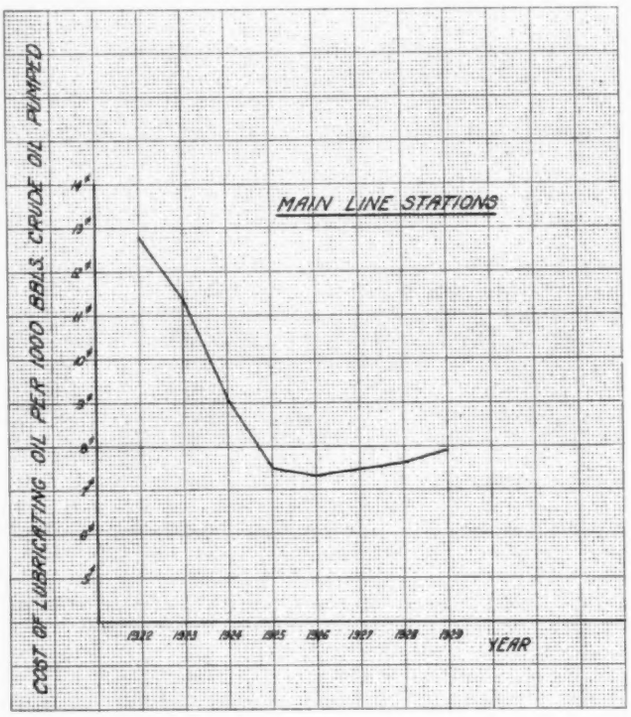
Sketch of typical gathering line station using a reclaimer.

equipment to give the operators clean oil for their machinery. It has resulted in furnishing the main line stations and the larger gathering stations with reclaimers and centrifugal machines. At the other smaller stations a small reclaimer or a filter is furnished.

A typical gathering line station using a reclaimer is shown in accompanying sketch. The dirty oil draining from the engine and bearings of the pump is led through a strainer well into a double-end pump. From here it is pumped into the overhead cone-bottom tank through a pipe leading to the cone of the tank and having a vent to take care of the air so as not to disturb the oil within the tank. From the bottom of the cone a large line is run directly to a reclaimer located immediately under the overhead tank. In this manner the dirtiest oil from the tank is always drawn into the reclaimer. When a batch of oil is cleaned, it is run into a receiving tank, thence to the other end of the double-end pump and again lifted into the cone-bottom overhead tank. Care is taken to spill this clean oil against a baffle or the side of the tank so that it will not rile or disturb the oil in the tank. A take-off for a gravity feed system to the engine and pump bearings is located six to ten inches above the top of the cone. A gauge glass is mounted on the overhead tank. The clean oil receiving tank can be equipped with a spout for drawing off oil to fill cups or bearings not fed by the gravity system.

The adoption of the system as mentioned above called for a reporting of the oil so that a monthly check could be made. It was necessary to have forms printed for the station operators to fill out and mail into the main office at the close of each month. A tabulation of these reports was made and a basic cost established.

Since the reducing of this cost to h. p. hrs. would entail considerable work and a careful check of time run and pressure pumped against, it was decided to base the cost against barrels of crude oil pumped. Available figures for this comparison are easily obtained. While the cost shown might not mean much to the average person, they furnish a means of comparison.



It is this opportunity, furnished the station operators to compare their cost with other stations, that brings about a friendly rivalry and prompts them to attain better results. Too much credit cannot be given to the friendly rivalry for the success of the system and hearty co-operation between the operators and the supervisor. It causes the operators to accept the proposals and advices tendered with a willingness that gets results.

With the advent of the economizing program and installation of present-day equipment, added benefits are derived other than merely the savings shown in lubricating oil cost. The new equipment and constant supervision naturally gives a cleaner oil and cleaner oil means fewer burned-out bearings. Fewer shutdowns follow and ultimate results are lower operating cost and more revenue because of more oil run.

The effecting of this system is, however, not without cost. It means that one man must give this work constant supervision. By this, I mean a periodic inspection of the station and equipment, but does not mean that 100 per cent of the man's time is spent on this item alone. He is at the station and can give to the other items that come under the mechanical department the attention that they need. Add to this the cost of the new equipment and necessary labor for installation.

Let us take, for instance, the case of a typical gathering line station and analyze the cost. To equip such a station with the units as indicated in the diagram will incur an expenditure of approximately $375.00. The Prairie Pipe Line Company has its own shop and by making the tanks and reclaimer can easily stay within this estimate. From past experience, the life of this equipment will run well over ten years, but for our analysis, let us assume a ten-year life. This means, then, that the equipment will cost in the neighborhood of $60.00 per year, figuring interest on the investment at 6 per cent. One should add to this about $25.00 per year per station for supervision. This might appear low, but it should not be forgotten that only a part of the time spent at a station by the supervisor will be devoted to checking the lubricating oil and equipment. As a total, then, one would have $85.00 as the cost per gathering line station per year.

The average cost of repairing one crank pin or wrist pin bearing for a 100 h. p. Diesel engine would be as follows: Rebabbitting and bore $20.00, average freight cost to and from shop about $5.00, and cost of installation approximately $15.00, which covers labor, machinist's expenses and expenses on car. Assuming it would take four hours to replace a bearing, then, revenue lost for four-hour shutdown would be $0.20, the gathering charge per barrel, x 120 barrels per hour, the capacity of pump, x 4 equals $96.00. This gives a total cost of $136.00. Of course, some gathering stations cannot be penalized the $96.00 for this loss of revenue because it is agreed that they could make up the pumpings later since they do not run a full twenty-four hours every day. However, there are some stations where a shutdown would be a penalty and for that reason, one must consider the cost. If you credit the lubricating oil program with the elimination of one burned-out bearing a year at each station, and you can safely assume this, one would have as a saving $136.00 against an expenditure of $85.00. This merely shows that by saving one burned-out bearing per year at each station, one will more than save the cost of carrying on the program and the savings in lubricating oil as shown in data sheet are a clear profit. The same analogy can be applied to the main line stations and while it is true the initial expenditures are greater at these stations, the possibilities for saving more than one bearing per year are increased inasmuch as there are a greater number of units at these stations. In other words, the savings made by de-

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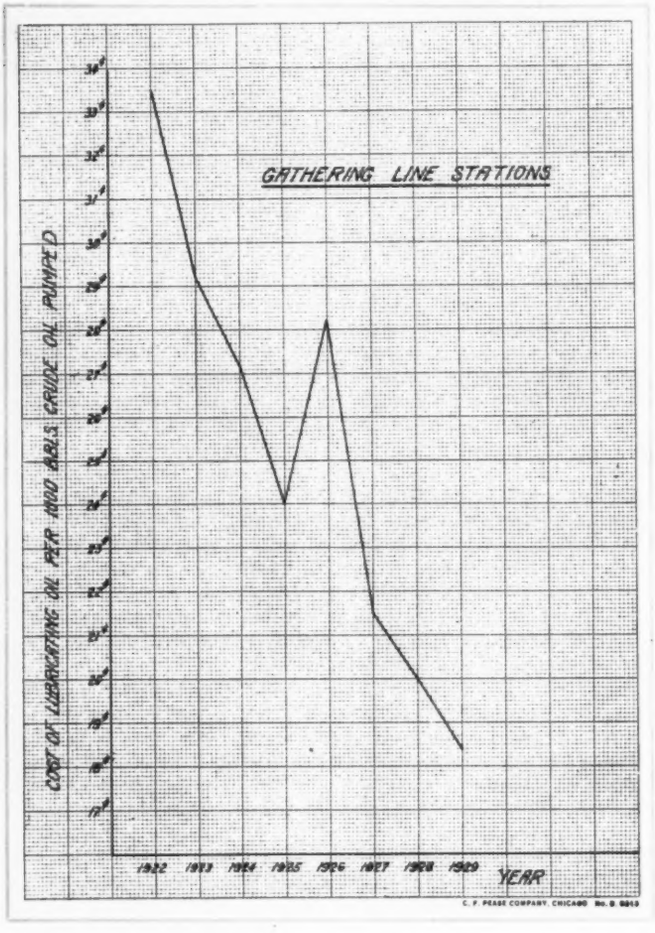
creasing the number of burned-out bearings are far more than the expenditures necessary to carry on the economizing program and the savings shown on lubricating oil cost are a clear profit.

In analyzing the curve of the main line station cost, one observes that there is a slight increase in cost for the past three years. The reason for this can be readily explained. During 1927, the Prairie Pipe Line Company was making the installation of its Panhandle line. This called for an initial expenditure to fill the lubricating oil system at each point. During 1928, the increase is attributed to the fact that the Panhandle line was operated at less than one-half capacity which naturally brought about a higher cost. The increase for 1929 can be attributed to the new work and installation of new units at Panova, Manuel, Cherokee and Cobb. This again, as in 1927, called for an expenditure to fill the new systems at each station.

The graph for the gathering line stations shows one decided break. This occurred in 1926. It was during this year that more urgent work at the main line stations took all of the time of the supervisor, which resulted in complete neglect of the gathering stations. The results are very apparent and bear out a statement made above that constant supervision is a major part of the program.


GATHERING LINE STATIONS
COST OF LUBRICATING OIL PER 1000 BBLS CRUDE OIL PUMPED
1922 1923 1924 1925 1926 1927 1928 1929
YEAR

The average reader, no doubt, wonders why the main line station cost is less than half of the gathering line station cost. There are two reasons for this. First and of major importance is the fact that each gathering station handles the oil twice that it is credited with pumping, once from the field to the tanks and then from the tanks to the trunk line station. The main line stations have their oil delivered into tanks from the preceding station and as a result, handle the oil once. Second, the average gathering station operates at a very low capacity while the capacity of the main line station is practically 100 per cent for the time each unit is in operation.

In this brief article I have endeavored not to give details as to how one should attempt to handle a lubricating oil problem, but rather to bring to the average man's attention, that in the lubrication of machinery, there is the possibility of making a major savings. This savings is possibly overlooked in a great many cases, but is of such magnitude and is so easily attained that it should receive the attention of all concerned and will bring a favorable return on the investment.

HYPOTHETICAL DATA SHEET

Assume that a pipe line system handles 950,000 barrels of crude oil daily at all of the main line stations during 1929, and that the gathering stations handle a daily average of 250,000 barrels of crude oil. This, it must be remembered, is the total of all the stations averages and is not the daily average runs for the system.

Also assume that this system operated during 1929 with a lubricating oil cost as shown on accompanying graphs for the year 1922, which would be $0.128 per 1,000 barrels crude oil pumped for the main line and $0.335 per 1,000 barrels crude oil pumped for the gathering line stations.

Then again assume the system to operate with a lubricating oil cost equal to that shown for 1929, which would be $0.0795 for the main line and $0.1836 for the gathering line stations. A tabulation of the savings follows:

MAIN LINE STATIONS

Daily cost for lubricating oil for 950,000 barrels of crude oil pumped based on the 1922 average would be—	
950 x $0.128 equals	$ 121.60
The cost for the year would be—	
365 x $121.60 equals	44,384.00
Actual cost based on 1929 average would be—	
950 x $0.0795 x 365 equals	27,566.63
Savings for 1929 over 1922 are	$16,817.37

GATHERING LINE STATIONS

Daily cost for lubricating oil for 250,000 barrels of crude oil pumped based on the 1922 average would be—	
250 x $0.335 equals	$ 83.75
The cost for the year would be—	
365 x $83.75 equals	30,568.75
Actual cost based on 1929 average would be—	
250 x $0.1836 x 365 equals	16,753.50
Savings for 1929 over 1922 are	$13,815.25
Add to this the main line stations' savings	16,817.37
TOTAL SAVINGS FOR THE ASSUMED SYSTEM FOR 1929 OVER 1922	$30,632.62

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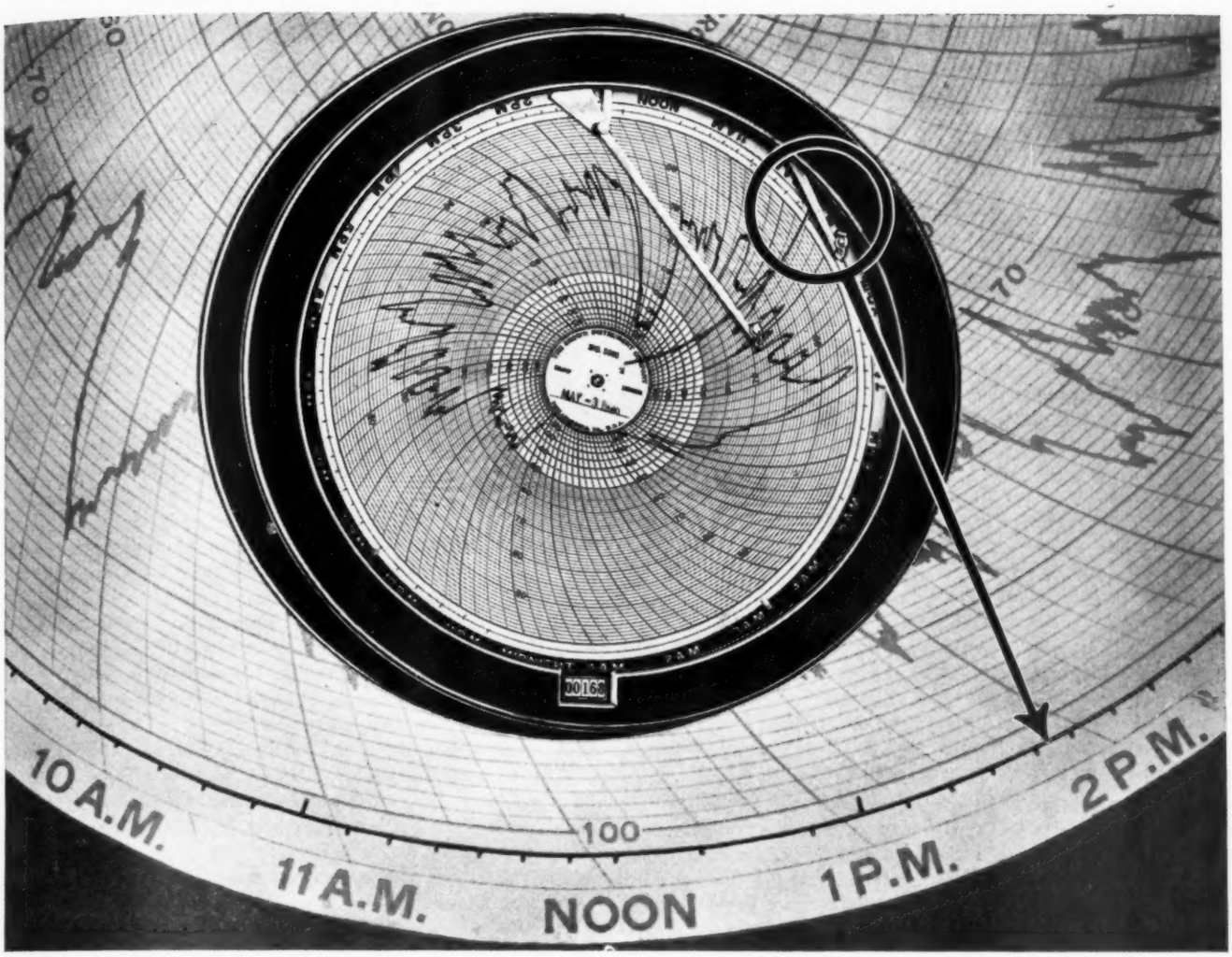

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THE Automatic Recording Planimeter in the Brown Electric Flow Meter is perhaps the most important flow meter development of recent years.

This exclusive Brown feature automatically records volume units on the chart. Any portion of the flow may be determined at any time without using a hand planimeter.

Write for Catalog 21—Brown Electric Flow Meters—or have a Brown Engineer call and discuss your needs.

THE BROWN INSTRUMENT COMPANY
4475 Wayne Ave. Philadelphia, Pa.
Branches in 20 principal cities

"to measure is to economize"

Brown Electric Flow Meter

on the Inductance Bridge Principle

When writing THE BROWN INSTRUMENT CO. *please mention The Petroleum Engineer*

Modern Facilities Aid in

Reducing Oil Field Fire Hazards

THE Oklahoma City field is probably better protected against fire and for the fighting of fire than any other field in the country. About the only type of fire thus far experienced that could not be conquered quickly is a serious well fire. However, with the equipment and facilities on hand the spread of this type fire is more readily prevented. One of the reasons for the excellent fire-fighting facilities dates back to the earlier development period of the field when the I. T. I. O. Co. built an elaborate water system for the drilling wells and steam plants. This system brings a water main around each lease and the water is pumped from a nearby river to a main station and a booster station. Later the I. T. I. O. Co. and the Foster Petroleum Corp. purchased a fire truck completely equipped to use in fighting oil and electrical fires. Going further, each of the company's tank batteries is equipped with risers that can be used to direct steam or foam into each tank. Another important feature is the constant inspection of properties to reduce fire hazards. Direction of all fire-fighting measures comes under the safety department.

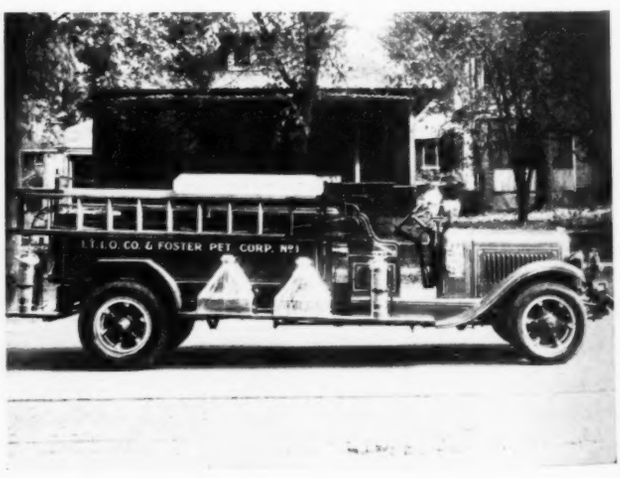
P. O. Wall

The truck is housed in a separate building at the central warehouse where much of the reserve equipment and material is stored. P. O. Wall, a fireman with many years' experience, is in charge and lives in a cottage adjoining the station house, subject to call at any hour. Every lease is connected to the company's main switchboard and with this system can report a fire very quickly.

Water connections have been installed at each warehouse, camp, office and plant. Whenever a fire is reported foremen and gang pushers on adjoining farms have instructions to join the group fighting the fire and bring whatever equipment they may have in the way of shovels, etc. Upon the arrival of the truck and the men coming from the central warehouse responsibility for fighting the blaze is turned over to Wall. In this manner ample labor is brought to the scene with rapidity. The truck is equipped with two portable foam generators capable of delivering between three and four thousand gallons of foam per minute. Twelve hundred feet of hose, 1,000 pounds of foam compound, 24 long-handle shovels, several hand-operated extinguishers for oil and electrical fires, an adapter for anything from one to four-inch pipe and a complete first air outfit are listed among the truck's equipment. The pressure pump on the truck which has a capacity for 400 gallons per minute is directly connected to the engine and can be used in the event of low pressure in the water mains. The truck has been in service since last November and has responded to three or four alarms each week. Something out of the ordinary is found in the standard equipment on all tank batteries. Each battery is equipped with a combination steam and foam line with the risers going into the top of each tank. A steam line extends along the battery on the outside of the fire wall. Where the laterals extend from the main line to the risers two valves have been installed. Anywhere from 200 to 400 feet away from the battery a water connection has been made and a hand set bull plug screwed in the nipple.

Whenever a fire breaks out in one of the tanks the fire is reported and the steam turned into that tank by means of the valve outside the fire wall. When the truck arrives the foam generator is set up and a water line connected to the nearby plug. A line is extended from the other side of the foam generator to the riser.

The connection for the foam line is just ahead of the steam valve on the down-stream side.



At left, detailed view showing steam line connections and risers on tank batteries. Note that both the steam and foam valves are on the outside of the fire wall. Above, P. O. Wall, in charge of the I. T. I. O. Co. and Foster Petroleum Corp. Oklahoma City field fire truck.

Transmission *and* Differential Lubricants

DR. WM. T. SIEBER, *Chief Chemist Waverly Oil Works*

TRANSMISSION and differential lubrication is a very important and vital factor in the present age of modern automobile transportation, and therefore, the automotive engineer is always on the lookout for efficient transmission and differential lubricants, which can be safely recommended by automobile manufacturers, and which will safeguard the motorist against all kinds of trouble and expense caused by improper lubrication. The ideal transmission lubricant — I say "ideal" because we are still very far away from having an ideal gear grease — should meet the following requirements:

1. It should give proper lubrication over a wide temperature range (from zero to about 150 degrees F.), which practically means that its consistency should be little affected by temperature variations. It should be an all-year-'round lubricant, which would eliminate the necessity of draining due to the change of seasons.
2. It should show a comparatively high stability, and should not break down after a few hundred miles of use.
3. It should not channel, but should show a great adhesion for the gears, and provide a great carrying power, combined with a cushioning effect.

Classifying the transmission and differential lubricants according to their chemical nature we have the following varieties on the market, all of which have their advantages and disadvantages.

THE value of an employee's services depends upon three human elements. They are muscle power, brain power, and will power. The one factor which we cannot estimate is will power. None of us can estimate what a given number of men can do when their efforts are affected by their contentment in their jobs, their enthusiasm for the task before them, and most of all, the team spirit by which they may be animated.—D. J. Moran.

Probably the oldest lubricant of this kind is the heavy steam-reduced cylinder stock, and a good many automobile manufacturers still recommend an oil for transmission lubrication—and the old standby, the Penna 600 W, is widely used. It gives wonderful performance, but has the drawback of having a high cold test, which makes it very undesirable for winter use, especially in cold climates.

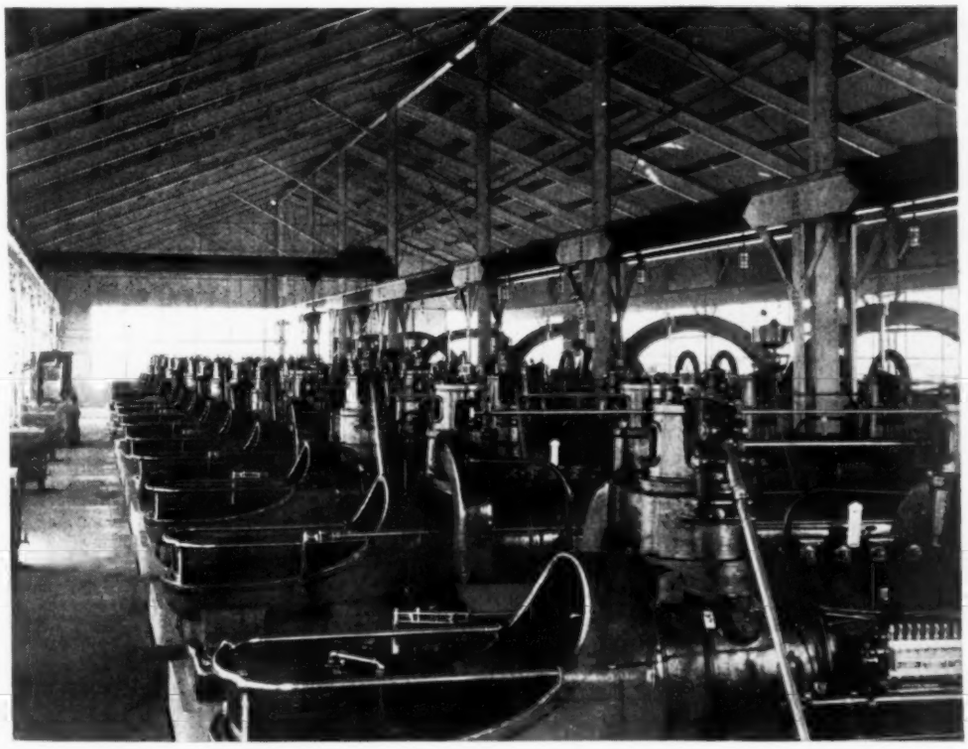
Lately this has been remedied to some extent by the blending cylinder stocks of different origin, and so making a transmission and differential lubricant of good quality.

The physical characteristics of a typical Pennsylvania transmission oil are as follows:

Gravity—26.0-27.0 Be.
Flash—550-565° F.
Fire—635-650° F.
Sayb. Visc. @ 210—145-155 sec.
Cold test—approx. 50° F.

A typical transmission oil, obtained by blending cylinder stocks of different origin, shows the following tests:

Gravity—22.0-24.0 Be.
Flash—approx. 400° F.
Fire—approx. 500° F.
Sayb. Visc. @ 210—145-155 sec.
Cold test—0-10° F.



A gas booster station in Texas. Plants of this nature do their share of consuming lubricants.

We find such a large variety of transmission and differential greases on the market that it is practically impossible for the layman motorist to decide which type is best suited for his use. Therefore, he is guided to a great extent by the recommendations furnished by the automobile manufacturer.

During the last few years quite a number of lime soap base gear greases have appeared on the market, which it is very doubtful if their quality is such as to warrant their popularity. Practically all of these lime greases have a very poor stability—they break down to a granular mass, or a thin oil, which has very little lubricating power, and which shows very little resistance to leakage. However, this type of grease finds particular favor in cold districts where ease of shifting gears is an important factor.

These greases have practically the same composition as semi-fluid cup greases in which a low cold test cylinder stock is used instead of the usual neutral mineral oil.

The following is a typical analysis of a light and medium limesoap base transmission and differential grease:

	Light	Medium
Tallow	5.50%	12.50%
Lime (hydrated)	.83%	1.87%
Cylinder Stock	93.42%	85.13%
Water	.25%	.50%

The procedure of manufacture is the same in this case as used for making cup greases.

The next and probably most used type of gear lubricants are the soda soap base transmission and differential greases. They are found on the market in a great variety and come very close to the requirements of the ideal gear lubricant. Since a soda soap has a wonderful thickening power, only a comparatively small percentage of soap is required to give the grease the necessary body. It has been found that the soda soap made from vegetable oils gives the best transmission lubricants, as they impart the necessary cushioning effect. Soda base gear compounds can be made with any kind of still residue, and always show a slight free alkaline reaction. This is absolutely necessary in order to give the lubricant the required toughness.

The following are the approximate typical analyses of medium and heavy soda base transmission greases, but these formulæ are subject to a good many variations, which local conditions may make necessary.

	Medium	Heavy
Corn Oil	4.00%	5.00%
Caustic Soda	.56%	.70%
Cylinder Stock	95.44%	94.30%

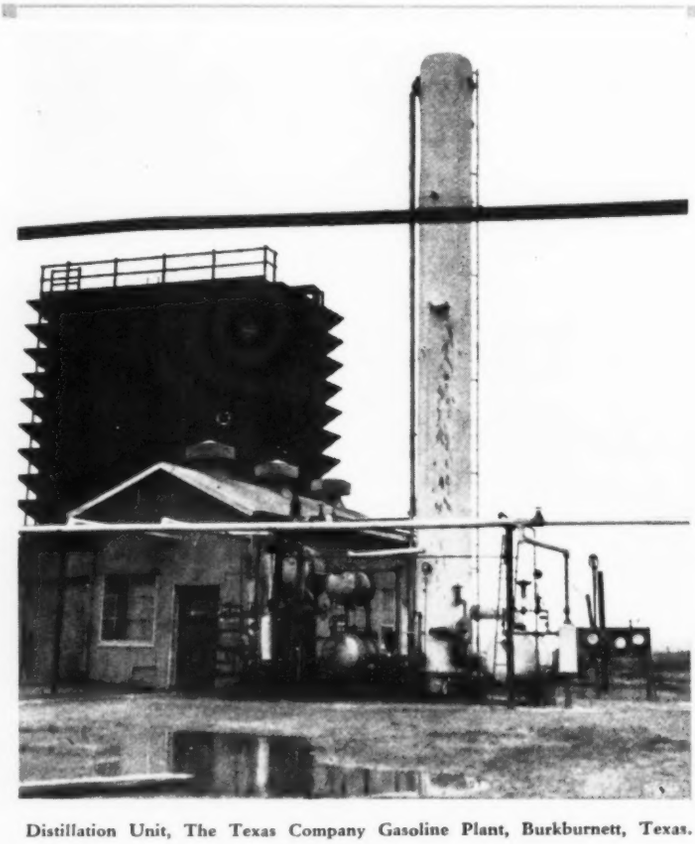
In making a transmission grease of this type, it is always advisable to make a heavy soda fibre grease first, which in reality is a transmission grease concentrate, and then reduce this fibre grease with the necessary amount of oil until the desired consistency is obtained. By following this procedure, the danger of the soda soap forming small, hard lumps is greatly reduced and the result is a more uniform and homogeneous grease.

One of the more rare types of gear compounds with which the motorist comes in contact is the aluminum soap base transmission lubricant. This is essentially a cylinder stock—possibly of various origin—thickened with aluminum oleate. Three-five per cent soap is usually sufficient to give the grease the required consistency. The initial appearance and character of these transmission compounds are usually quite deceptive, although they possess adhesion for the gears and are non-channelling, the life of these desirable characteristics is limited, as this class of lubricants is unstable and breaks down over a short period of time.

With the advent of newer designs in modern motor car transmissions and differentials, it had become necessary to develop a more efficient gear lubricant, which embodies slightly different characteristics than any of the other transmission greases heretofore manufactured—the result has been that lead soap base gear compounds were perfected to meet this demand. In appearance these lead greases resemble a straight transmission oil and are essentially different from the stringy and fibrous nature of the soda soap base class, inasmuch as they are smooth, free-flowing and very unctuous. They produce a more stable lubricating film—they more effectively reduce friction and they resist the scraping and squeezing action of the gears in the modern high-speed transmission and differential assembly. The basic part of these gear greases is the lead soap, which is made by the action of lead salts on fatty oils—mainly fish oil—using one of two methods, either the fusion method or the method of double decomposition.

Another class of gear compounds—although in the minority should be mentioned—they are known as "Densified Oils". They are, just as the name implies, merely cylinder oils, thickened up to most any consistency by the use of mineral fillers, such as asbestos fibre, bentonite, clay, paper pulp, etc. The lubricating power of such products is none other than that which is embodied in the cylinder oil which they contain.

In view of the great number of the transmission and differential lubricants—the selection of one of which would keep the average motorist's brain in a whirl—I would suggest "Quality First" and then the lubricant best suited to the particular design of equipment in which it is to be used.



Distillation Unit, The Texas Company Gasoline Plant, Burkburnett, Texas.

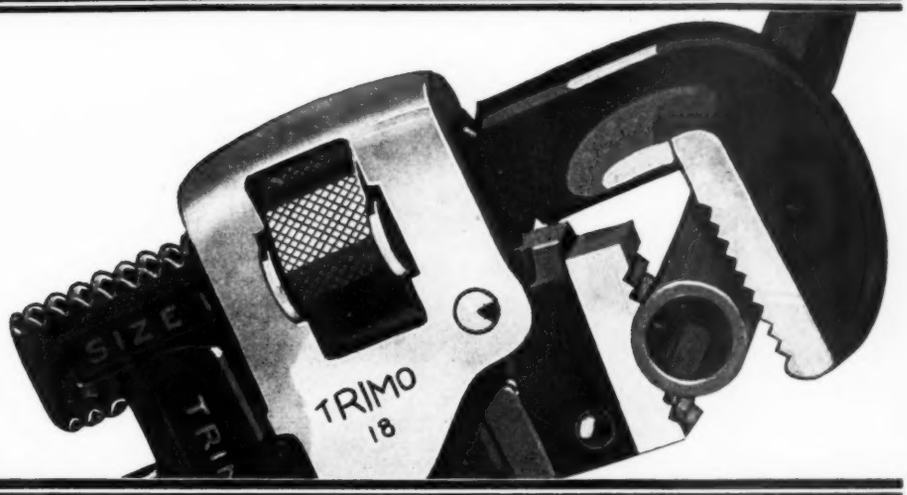
Alibis and Progress

WE are all inclined to think a great deal about what we call our "handicaps." Sometimes we blame our lack of success on our territory; sometimes on the house; sometimes on the product.

Men with the winning strain don't need alibis. They have them, but never use them. That is why they outrival the others.

—*Conoco Magazine.*

TRIMO



Year after Year the Men Who Know Stick to the Wrench that *Does Not Break*

PURCHASING TOOLS is not a thing to be learned over night. Years of experience build up the sound sense of values that leads to making the right choice.

Regarding pipe wrenches, a talk with the seasoned purchasing agent or a check-up of requisition sheets will bring out one striking fact. Year in, year out the men who really know have stuck to TRIMO because of its consistent ability to stand terrific punishment without breaking.

New tools have come and gone—new claims of better performance or lower cost. But in the face of the hardest competition, TRIMO stands today where it always has stood, as America's finest pipe wrench—the choice of the men who know.

TRIMO
Pipe Wrench

All Steel for Strength

Handle Drop Forged Not Cast

Made by TRIMONT MFG. CO., Inc., Roxbury (Boston), Mass.

When writing TRIMONT MFG. CO., INC., *please mention The Petroleum Engineer*

Attention to Minor Problems is

Speeding Gas Line Construction Work

Top to bottom—Old Joe hitched to the cart used to transport the tack welder's outfit; a ditcher ripping through country made difficult to ditch because of the roots; lifting a 100-foot section of 10-inch line with a boom tractor.

WHEN the Cities Service Gas Co.'s 81-mile, 10-inch welded gas transmission line from Joplin to Springfield, Mo., was completed through rocky country in 71 days last fall and winter, it was attention to small details that contributed most toward making good time.

Two crews were started at the same time, one starting from the middle and working toward one end of the line and the other starting from the opposite end and working toward the middle.

For the most part the ditching was through rocky country, taxing the ditchers greatly. Very little blasting was necessary although some sections ran up the maintenance cost on the machines.

The tractors had varied uses throughout the construction work. In the bottom lands which were muddy, they were hitched to a string of five or six trucks, all using their own power, to pull the loads of pipe.

Twenty-foot joints were used throughout. Five joints were usually welded in 100-foot sections and picked up and lowered on the skids. Tractors were also used to pick up the line while it was being coated with a hot application. Their final use was in backfilling.

One man on the job made the reputation of walking 81 miles backwards. He poured all of the hot application of paint that was used, while the tractor held up the pipe to permit more rapid time being made on this phase of construction.

A new method of tack welding was developed during the construction job when a cart was built to carry the two tanks for the gas welding instead of hauling more heavy equipment over the line. At that time a hardened teaming contractor's horse was made more familiar with the luxuries of animal life.

The cart was built with old pipe. Shafts were made with 2-inch pipe welded to frame, also made of old pipe. A pair of wide wheels were obtained and the axle welded to the frame. The frame was designed to accommodate two tanks and braced so the tanks would be rigid while being transported.

The horse, "Old Joe", was soon taught the duties of moving along to another joint each time the tack welder finished tacking a joint. A few sweets were used to hurry up his education. With the light and portable outfit the tack welder could move along the job more quickly and especially in muddy low lands or up and down hilly country.

Rainy weather delayed construction work only a few days and the slight loss of time resulting from inclement weather was to a great extent made up by the experienced crews brought to this job from another. The few times the firing line worked too close to the stringing gang did not cause any tie-up in work because the tractor crews and extra help were called in to help with the stringing job.

Delays or lost time in welding were avoided as a result of the foremen being on the alert and having the necessary helpers around for the welders to prevent loss of time in supplying rods and moving material and equipment.

One gang finishing a little ahead of the other, the best men from the gang whose job was complete were moved over to the other camp to help in the final work. Throughout the job, from stringing to backfilling, careful attention was given to the detaii work.

TALK NUMBER FOUR BY A PROMINENT DISTRIBUTOR

"THINK—

Above—Mr. W. M. Bovaird, President of The Bovaird Supply Company of Tulsa, Oklahoma. This company's services are of a definite economic value to the prosperity of its business territory.

THINK of the economic waste to consumers of Industrial Supplies if they had to interview all the salesmen of all the manufacturers who make materials they use. They couldn't do it, and even if manufacturers had a sales force large enough to make the calls it would make the prices prohibitive.

We do that for our field which makes us an economic necessity—which makes our recommendations worth while, and we recommend Republic's Belting—Hose—Packing—Molded and Lathe Cut Goods."

The above statement is characteristic of those made by prominent distributors all over the country. It explains in part how the Industrial Supply Distributor, helping to solve the important problem of broad markets and *economical* distribution, upholds high quality, maintains fair prices and saves needless efforts on the part of both consumer and manufacturer.

Champion Oil Country Belting was made to stay on the drill rig or the power pump after years of experience in finding out just what a satisfactory belt for this service must do.

Ask for a sample of Champion Oil Country Belting and see for yourself why it will do any work in the Oil Fields.

THE
REPUBLIC RUBBER CO.
Youngstown
Ohio

●

REPUBLIC means the Best Mechanical Rubber Goods

When writing THE REPUBLIC RUBBER CO. *please mention The Petroleum Engineer*

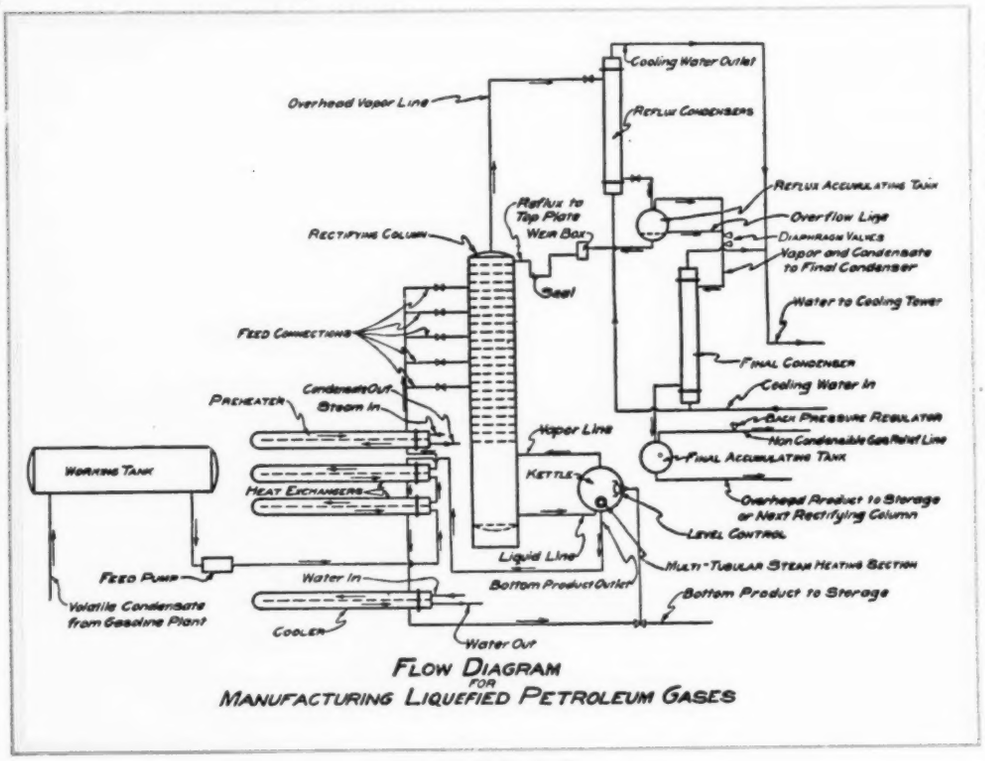
Efficient Rectification Produces

New Products *from*

Braun Fractionator

ECONOMIC and scientific developments have induced the leaders in the natural gasoline industry to develop new markets and to manufacture finished products for the consumer rather than only the various grades of natural gasoline which are intermediate materials used by refiners, often in too limited quantities, for blending their motor fuel to meet specifications. The larger producers are manufacturing and marketing directly to the consumer motor fuels of controlled volatility, which enable easy starting and rapid acceleration; stabilized aviation gasolines free from dissolved gases which might cause vapor locking; gasoline for speed boats giving maximum power to the two-cycle outboard engine; and special naphthas and solvents of close boiling range for various industries.

The lighter hydrocarbons, propane, and the butanes are sold in special pressure cylinders for domestic fuels or for industrial uses for gas enrichment and heat treating in metallurgical processes. During the past few years a new branch of the industry has been developed to manufacture, transport, and develop new markets for liquefied hydrocarbons extracted from natural gasoline. G. G. Oberfell estimated the consumption of liquefied petroleum gas for 1929 to be 15,000,000 gallons.



FLOW DIAGRAM FOR MANUFACTURING LIQUEFIED PETROLEUM GASES

Courtesy Philfuels Co.

Stabilized Natural Gasoline

The refiner usually buys the most stable grade of natural for blending his gasoline, since the production of Grade A natural is about 60 per cent of the total manufactured. The price differential usually makes this the most profitable to manufacture, but due to the lack of proper equipment some operators are still stabilizing by weathering, which results in a loss of yield and profit.

A change in specifications for the various grades of natural gasoline by the Natural Gasoline Association would require efficient rectification since the gravity and recovery specifications would be replaced with the vapor pressure and same point on the A. S. T. M. distillation curve. From these properties the percentage of the lighter hydrocarbons can be closely estimated. In order to meet changes in demand for the various products so that a maximum profit

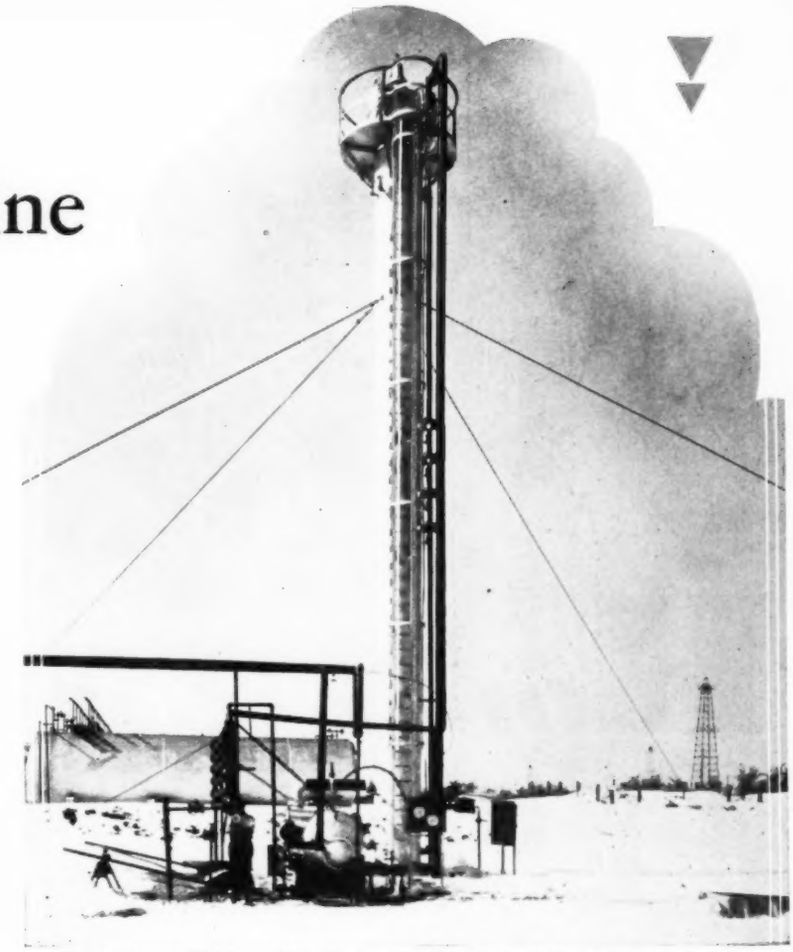
By
F. R. STALEY

Natural Gasoline

will accrue to the manufacturer, it is necessary to have fractionating equipment that will assure flexibility and maximum yields of the higher-priced products. It is necessary to make a sharp separation of the hydrocarbons present in the raw gasoline so that none of the more valuable hydrocarbons are lost.

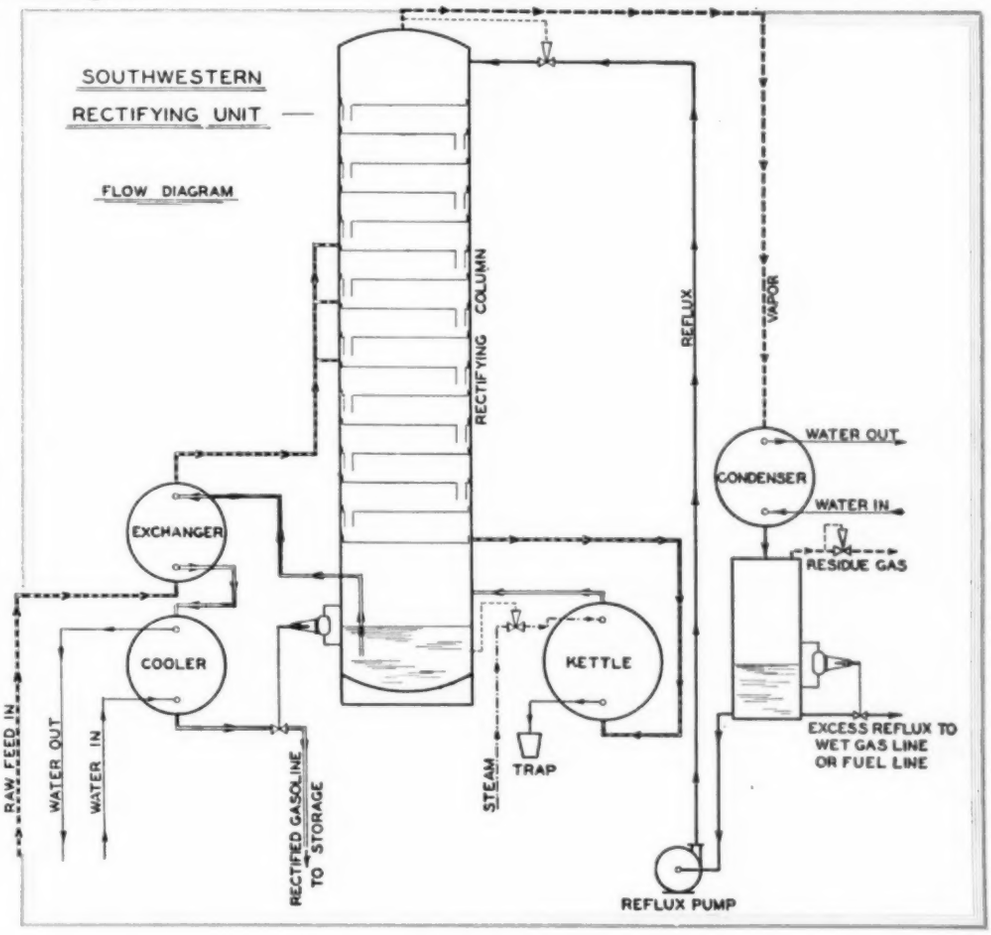
Aviation Gasoline

At the present time Dr. G. G. Brown is directing research work on aviation gasoline, in which data will be collected on actual flight tests in specially equipped airplanes. By proper rectification, aviation gasoline of very low gum content is manufactured from natural gasoline. Usually the sulphur is very low and no treating is required. Bridgeman & White (S. A. E. Journal, March, 1930), pointed out that vapor-locking tendency was an important consideration. Aviation gasoline should be free from propane and dissolved gases. The authors define vapor-locking temperature as the temperature at which the vapor pressure of the gas-free gasoline equals the external pressure on the gasoline in the fuel feed line at a point where marked vaporization occurs.



Fractionator at Oklahoma City plant. (Courtesy Tulsa Boiler & Machy. Co.)

Engineering companies are now building rectification units for the natural gasoline plant operators, which enable them to make finished products, economically and efficiently, to meet changing market conditions. Figure 1 is a flow diagram of a rectifying unit of this type. The vapors leaving the rectifying column pass through the condenser. The condensate collects in the receiver while the vapors are liberated through a back-pressure valve at the top. The reflux is removed from the receiver by a pump and returned to the top plate in the column. The amount of liquid returned to the tower is automatically controlled from the temperature at the top of the column. The condenser is operated to give a maximum condensate, and the excess not used for reflux is flashed off into the inlet or residue gas lines. By this method the gasoline is rectified. In some systems the rich oil is rectified. The design and type of rectifier required for a given plant will depend upon the products desired and upon the raw material to be processed.



The explosion that bent this TUBE-TURN actually made shrapnel of every other type of fitting on the job— including a cast steel valve and several screwed ells.

How's this for STRENGTH?

A 90° type.

TUBE-TURNS

are neither bends nor castings. They are short-radius fittings *forged* from seamless tubing without thinning of outside walls, buckling of inside walls or flattening of cross-section. They are made in 1″ to 18″ I. P. S. and in 1½″ to 12″ Extra-Heavy. All their measurements—I. D., O. D. and wall thickness—agree with Standard and Extra-Heavy Pipe. *Stocked* in 45°, 90° and 180° types, both standard and extra-heavy, by these distributors:

DISTRIBUTORS

***Baltimore*, The Heat and Power Corp. . . . *Cambridge*, Baker Supply Co. . . . *Cleveland*, M. S. Maleson Co. . . . *Detroit*, C. E. Phillips and Co. . . . *Houston*, Maintenance Engineering Corp. . . . *Los Angeles*, Buck and Stoddard . . . *Pittsburgh*, Herr-Harris Company . . . *Toledo*, Mason Equipment Co. . . . *Tulsa*, The Moorlane Company . . . *Seattle*, *Tacoma*, *Portland*, Asbestos Covering & Supply Co. . . . *Honolulu*, Hawaiian Gas Products, Ltd.**

BEFORE the explosion, this battle-scarred veteran was a 2″ I. P. S., 90° TUBE-TURN installed in the starting system of a gas booster station. The pipe itself was ripped open in several places. A cast steel valve and several screwed fittings were blown literally to bits. The Tube-Turn (the only one in that particular line) was bent almost double—

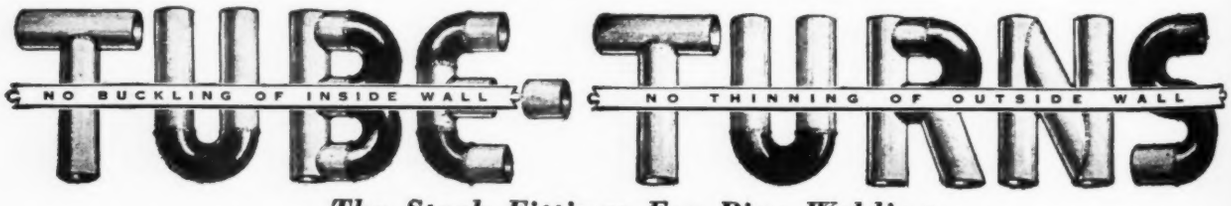
but neither the Tube-Turn nor the weld was fractured.

In the same plant, another 2″ Tube-Turn is functioning under 2,000 pounds pressure, 200° F. temperature and at the same time withstanding continuous, excessive vibration.

If you have especially tough jobs to deal with—if you encounter unusual temperatures and pressures—if you are interested in stronger, better piping *at less cost*, we will appreciate an opportunity to send you all the facts about TUBE-TURNS. No obligation.

TUBE-TURNS, *Incorporated*
1307 S. Shelby St., Louisville, Ky.

CHICAGO	NEW YORK	PHILADELPHIA
110 S. Dearborn St.	*30 Church Street*	*Bourse Bldg.*



The Stock Fittings For Pipe Welding

Protected by U. S. and Foreign Patents

California Company Finds Experiments Aid in Obtaining Better Drilling Results*

By
F. F. HILL[1]

THE demand for better drilled wells has become one of the foremost considerations of oil development within the past few years. Some of the causes for this demand may be found in the following:

Difficulty of drilling; frequent fishing jobs; trouble in pumping; excessive wear of tubing and rods, with the consequent loss of time and production by parted rods and leaking tubing. Also the failure in correlation between certain wells, sometimes when very close together on the surface or where drilled between two others of which logs were of record, the unexplainable presence of water in some wells, where neighboring ones, even though supposedly more unfavorably located, continue to produce clean oil in satisfactory quantities; the drilling off of casing or tubing in wells; mudding up of producers; loss of circulation in drilling; circulating fluid coming through some other well in nearby vicinity.

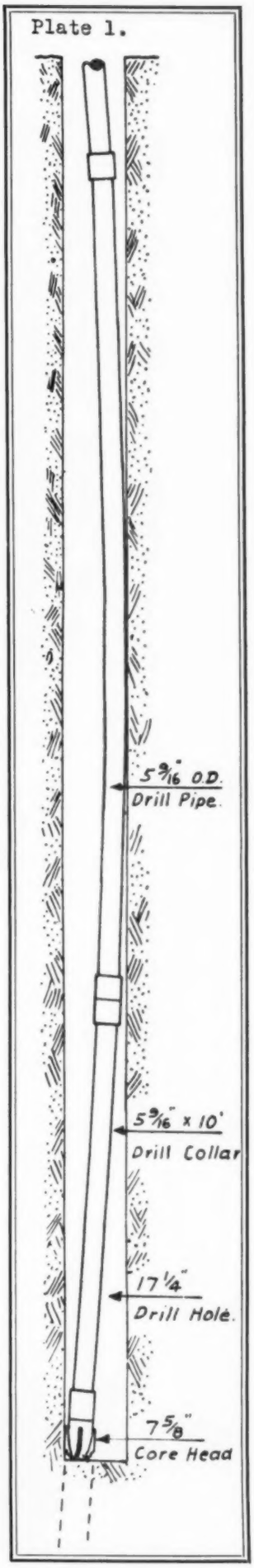
Gradually the operators became awakened to the fact that all was not so well underground as might appear on the surface and, as proof accumulated of the well's wandering, many devices were developed to try and determine the course of the drill hole, and some very interesting and useful instruments have been introduced and used for this purpose. But even though we accept the findings of these instruments, it does not correct the damage that has been done by not having vertical holes. Therefore, it was apparent that better methods must be employed in drilling and means provided to determine when a hole is leaving vertical and a quick and sure way of straightening, which as a rule is not difficult if taken in time and before casing is set; and really now in the best society it is considered poor operating if casing is set in a well that is not reasonably straight.

That more light might be shed on this subject and to find some of the contributing causes of crooked hole drilling and that corrective measures be adopted, the Union Oil Company of California constructed and operates a miniature drilling rig for demonstration purposes, where a study is being made under similar conditions as are found in drilling. Artificial blocks were made up of different earth materials mixed with cement to produce specimens of different textures, varying degrees of hardness, interbedded with hard shells, boulders, etc. Also, these strata of formations might be tilted at any angle to determine the bit action when encountering and drilling through these obstacles.

Aside from the experimental rig, the Union

*Paper read at A. P. I. meeting, Oil Equipment and Engineering Exposition, Los Angeles, March 20, 1930.
[1]Manager of Production for Union Oil Company.

Fig. 2—General view of experimental rig and some of the test blocks.



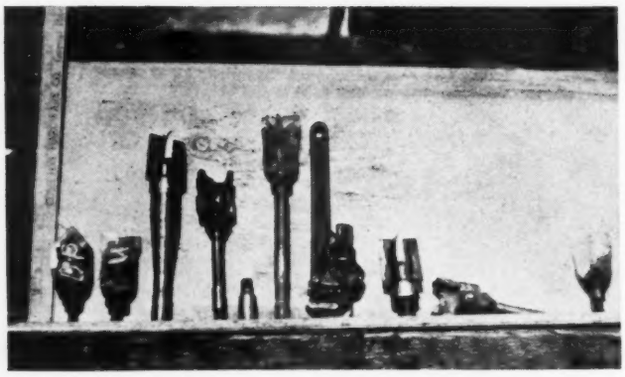


Fig. 3—Some small bits used in drilling, compared to an 18-inch wrench.

Oil Company of California has gone further by taking certain wells that started drilling in shale or hard formation and became crooked at shallow depths, the fluid was bailed out and lights used to inspect the walls, which showed plainly where the hole started to drift and in some instances the cause, but perhaps the most interesting and instructive feature of this experiment was the opportunity to observe in a dry hole with the human eye the actual performance of the straightening tools while forming new shoulders on the walls, taking off bumps, and otherwise making a good hole out of one that had a poor start in life.

Our investigations lead to the conclusion, and we feel that it is generally the opinion of others having made a careful analysis of drilling conditions, that the one greatest contributing factor in bad hole making is the attempt to force drilling beyond reasonable limits by applying too much weight to bit or riding a dull bit with excessive weight. This produces buckling of the drill pipe at the point of least resistance, which is usually just above the most rigid member in the drill stem column, nearest the bottom, which is the drill collar run immediately above the bit; the shorter the drill collar and the smaller the drill

Fig. 4—Spiral or rifling action of bit caused by wearing drill pipe.

stem in relation to the well diameter, the more acute the angle of deviation can become.

The starting of coring with a small core barrel in a large hole is a step in the right direction toward a bad hole, as the usual practice in coring is to run with considerable weight and rotate slowly. An exaggerated condition of this is shown in Plate 1.

Some of the recommendations for better hole making may be found in the following:

1. Do not permit drill pipe to buckle in hole by too much weight. It can produce a bad hole and cause unnecessary fishing.
2. Use only reasonable amount of weight on bit and feed regularly—or uniform pressure on bit.
3. Use long drill collar, the nearest diameter to the size of hole drilled; by leaving only such clearance as required for fishing, will help keep hole in alignment.
4. Drill the formation clean with as fast rotation as conditions will permit, and not try boring as with an auger.
5. Keep up good pump pressure and sufficient volume to wash hole clean of cuttings, have fluid discharge against that portion of the bit that will prevent mudding up of tools, and to wash bottom of hole freely, but not wash against

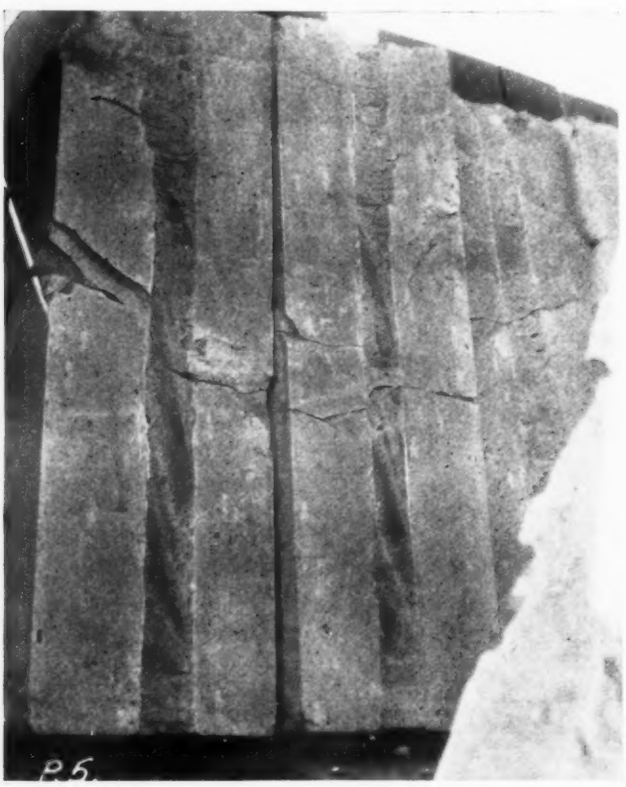


Fig. 5—This shows a start of cutting rings on wall by running too long in one place, then finishing up by rifling.

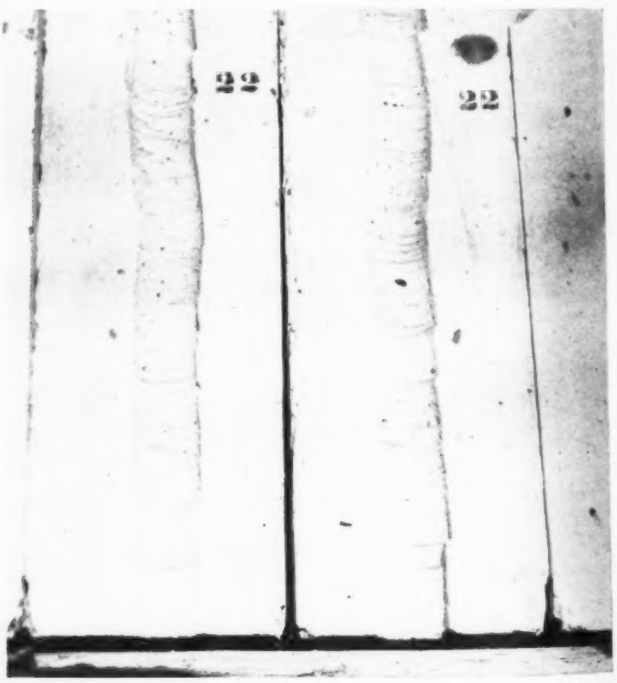


Fig. 6—This seems to be the result of just rotating, condition formed by poor drilling and poorly formed bit.

Fig. 7—Showing top and bottom of hole in fair alignment, but has ballooned out in soft formations.

the walls. Keep mud free from sand and larger solids; it saves pumps, drill pipe, supplies, and permits better drilling.

6. Keep bits sharp, use the best wear-resisting materials for cutting edges, dress drilling bits and core bits true to gauge so they will rotate concentrically with drill pipe axis, maintaining sufficient clearance above cutting surface of bit to permit bit to work back to vertical if it has been forced off by some minor obstruction. The natural tendency is for drill pipe to hang vertically in the hole and will drill accordingly if not forced out of plumb by some obstruction or by some operation contrary to the law of gravity.

7. Where reducing hole or piloting ahead with small tool, a good precaution is to center the new hole by rotating

Fig. 9—Showing progress in better hole-making and is a fair sample.

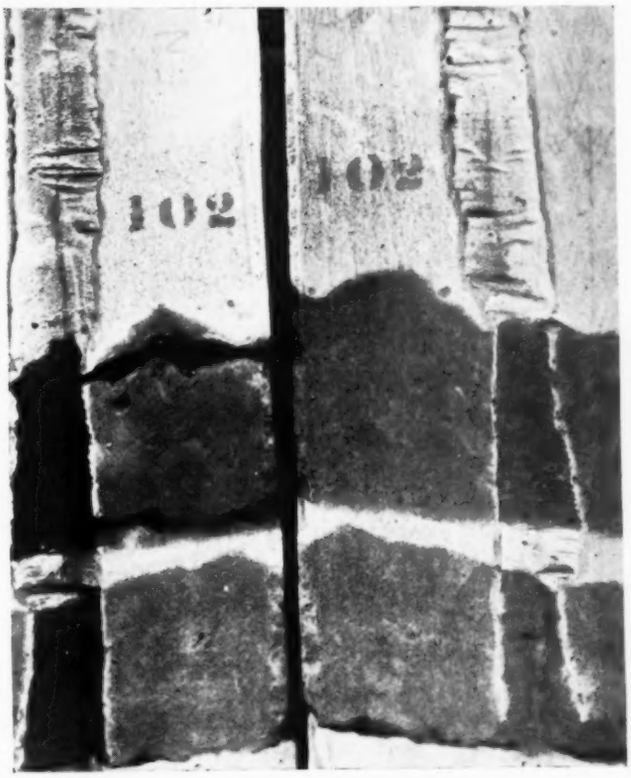


Fig. 8—Is a good example of what happens when a hard shell is encountered below soft shale. The bit is deflected following the dip of shell, burrows out larger hole than bit diameter, finally breaking through on high side of hole and bit working back to vertical. However, leaving a bad shelf on wall that would probably stop casing if it were run in hole without guide; also might cause bit to hang up while running drill pipe in hole and could cause a bad fishing job.

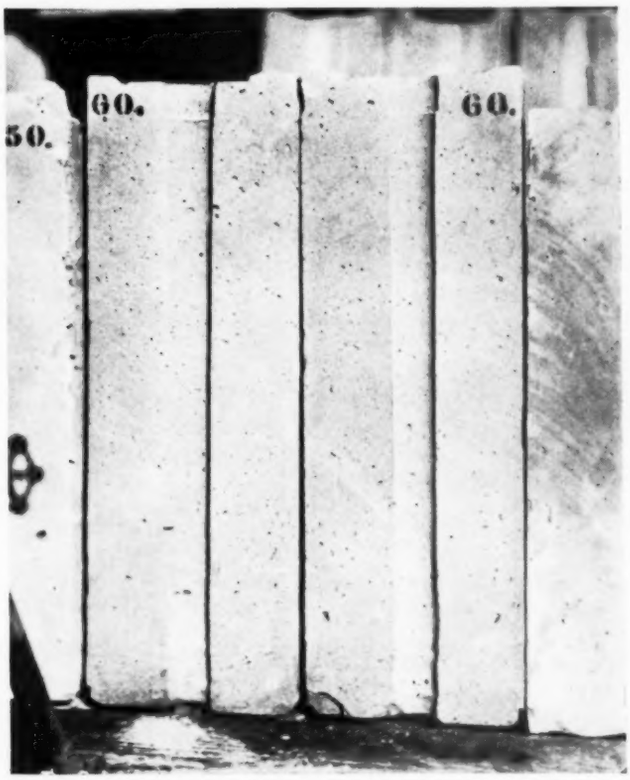


Fig. 10—Shows greater improvement and has produced practically a 100 per cent specimen.

a diamond point bit for a short way or use a guided pilot bit for starting off.

8. Lastly, and of greatest importance, educate the driller to what is expected of him, keep his confidence and get his co-operation, and better results will ensue. Certain geological conditions encountered in drilling will cause deflection of hole, but carelessness or failure to observe simple fundamentals is perhaps the most prevalent cause of crooked holes, and the driller is the one to overcome these conditions so long as he has under his control the hole-making equipment. For a good many years past the driller has been fast becoming a part of the mechanism instead of a thinking machine, as the ever-increasing call for faster hole has been the means of losing sight of the finer arts of drilling and has become a battle of speed, manufacturing, engineering, selling, etc., rather than workmanship and results following completion of well.

I do not mean that we should turn the clock backward and not feel that we have made progress in drilling, for we surely have, and gone ahead by leaps and bounds, especially in making hole and a lot of it crooked.

The operator is mostly to blame for this, as the drilling in town-lot areas has brought about a competitive condition where top speed is required and equipment is demanded by the operator to meet these conditions. The manufacturer has not only tried to meet these demands, but has tried to forge ahead by designing heavier and better equipment, and, as a selling argument for his goods, he promises faster hole-making.

Great strides have been made during the past year and, personally, I believe crooked holes are going to be a thing of the past in a remarkably short time, as there are enough instruments available now and enough knowledge of drilling technic to overcome this difficulty, and there is no reason to doubt that another year will see as great additional improvement in drilling as we have witnessed in the past one.

The other accompanying plates are illustrative of some of our experiments.

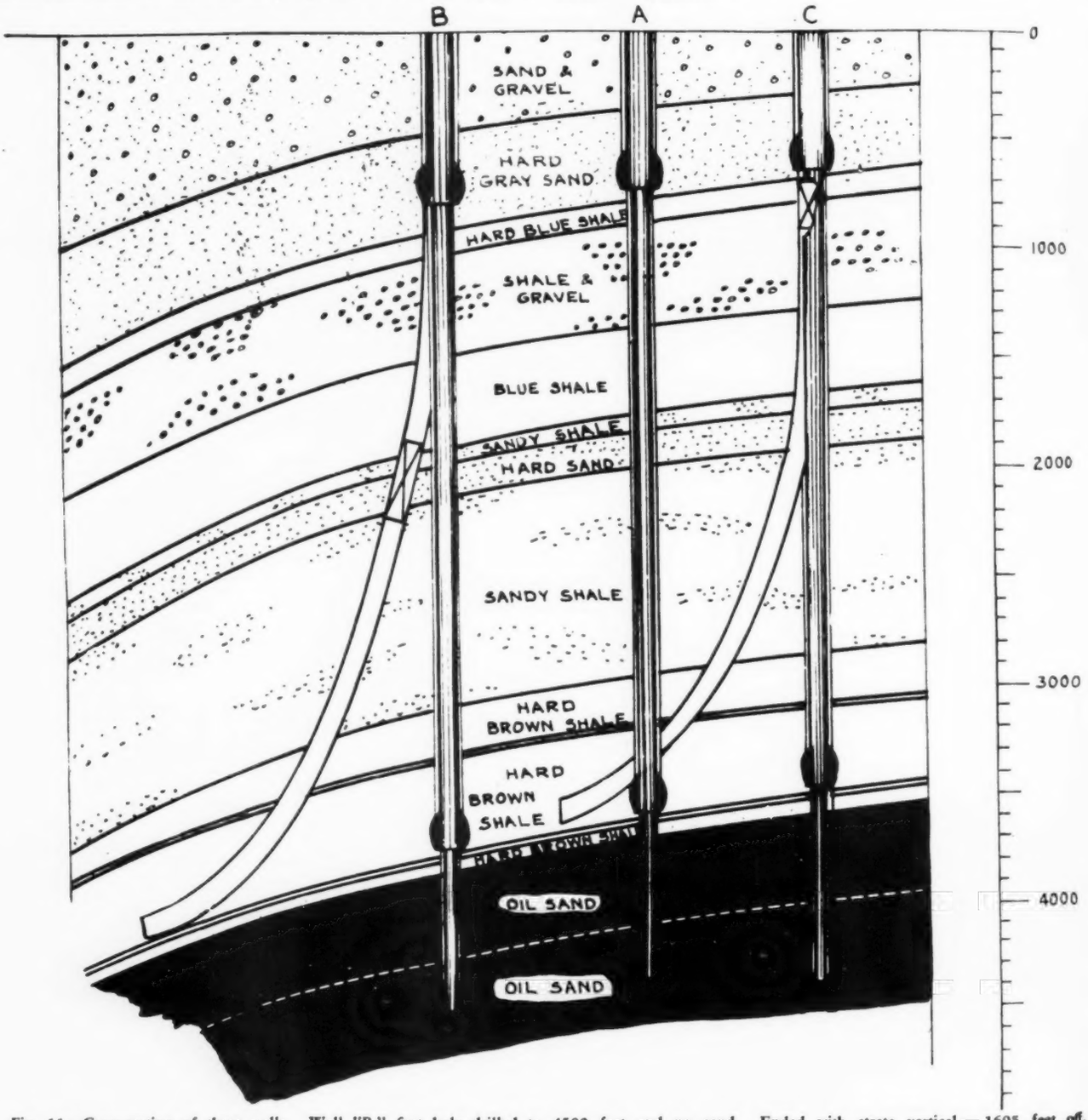
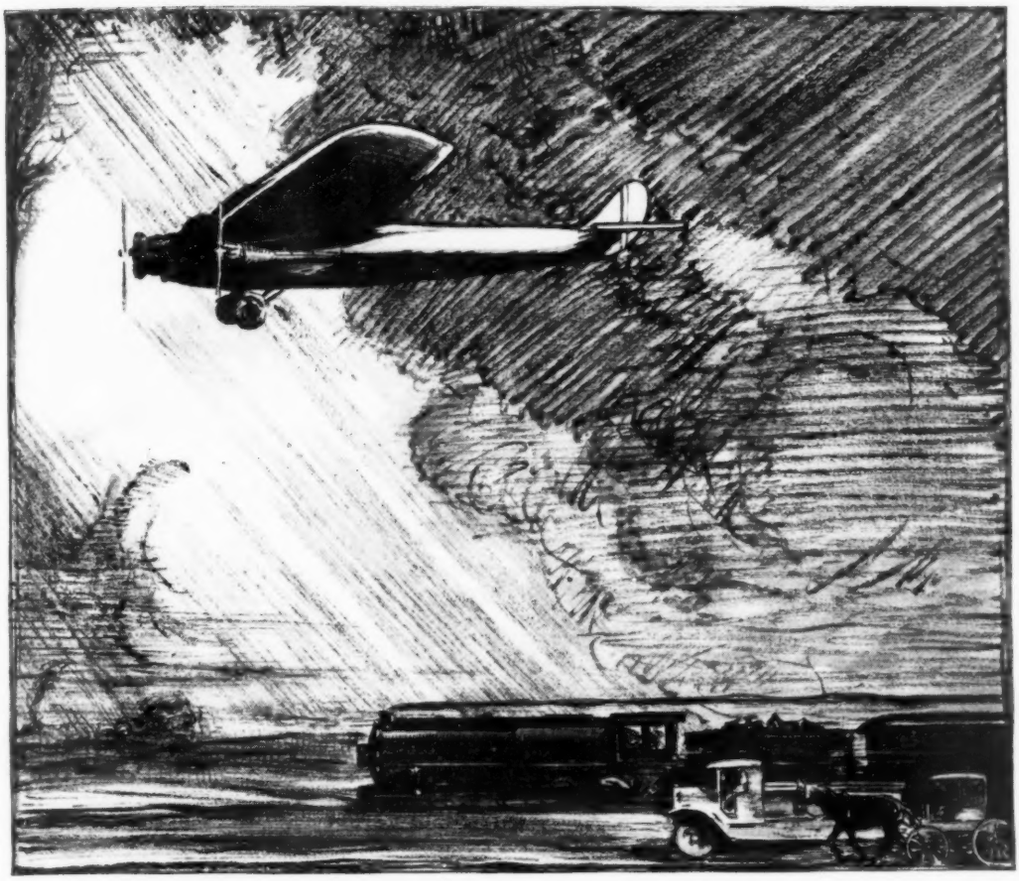


Fig. 11—Cross-section of three wells. Well "B," first hole drilled to 4500 feet and no sand. Ended with strata vertical — 1605 feet off. Second hole got sand at 3893 feet. Depth, 4526. Well "C," first hole drilled to 4200 feet and was 1200 feet off. Ended with vertical strata. No sand. Second hole got sand at 3870 feet. Well "A" was straight hole.



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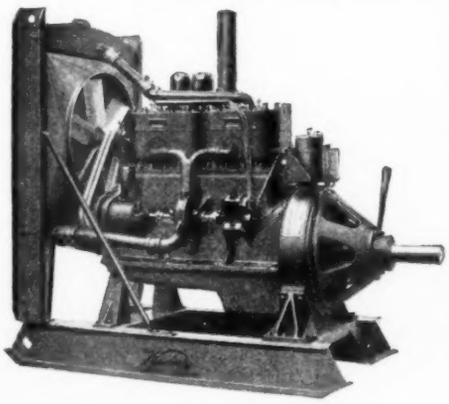

Bulletin 761 describes the Waukesha Great Six, 275 hp, for deep well rotary or cable tool drilling . . . Bulletin 788, the new Type-G Cable Tool Drilling Unit. Write *Oil Industry Equipment Division, Waukesha Motor Company, Waukesha, Wisconsin.*

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WAUKESHA ENGINES

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How Nations Without Crude Oil May

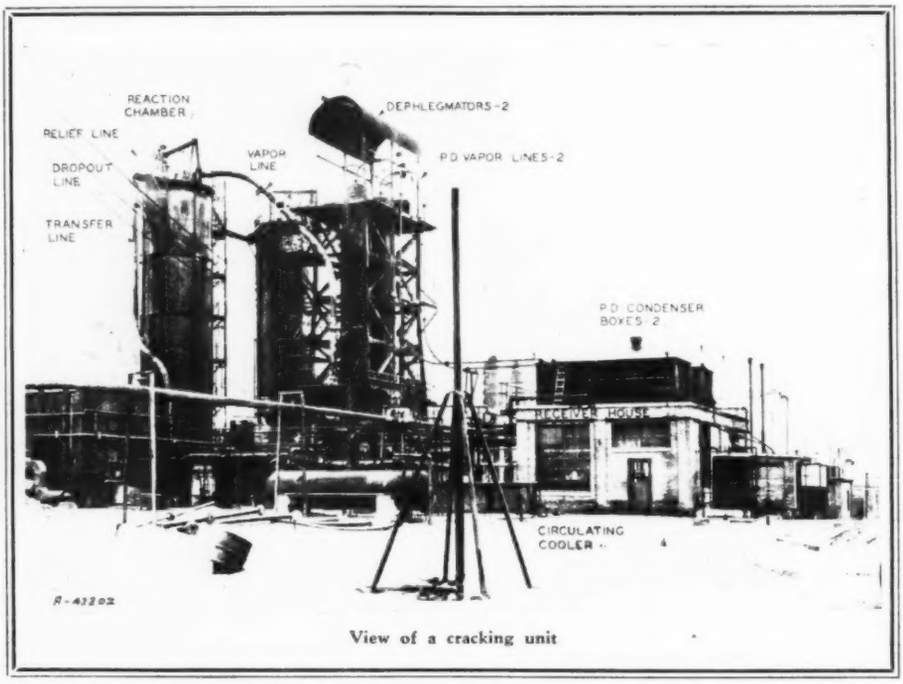
Safeguard the Future by Cracking

By PAUL TRUESDELL*

DEVELOPMENT of the cracking process has now reached the stage where it offers to countries which have no natural deposits of petroleum the means to overcome the handicap under which nature has placed them and put themselves practically on an equal footing with countries beneath whose soil lie pools of crude oil.

By installing cracking plans a nation can establish within its own borders an industry which will give employment to many of its citizens and which can supply in normal times a large part if not all of the motor fuel required to run their cars, at the same time producing as by-products coke and gas which have a high fuel value.

Cracking plants can provide the needed gasoline and other products economically either from fuel oil, gas oil or heavy crude oil imported from outside the country or, because of their extreme flexibility, they can utilize as charging stock shale oils, lignite oils, bituminous tars, wood tars, peat oils and even vegetable or fish oils if these are available at home.



View of a cracking unit

In most countries the chief source of cracked gasoline undoubtedly would be imported fuel oil, gas oil, or crude petroleum. As refining processes are conducted today they usually result in the production of an excess amount of fuel oil which can be bought at low cost. Also, there is almost always available plenty of low grade crude, perhaps containing little or no natural gasoline, which nevertheless would give high yields of excellent motor fuel by cracking.

That the building up of a gasoline manufacturing industry is possible in countries which have no crude oil at home is shown by recent installations in European countries.

In Italy, two companies have recently installed cracking units and in Belgium a small plant has recently been started. The two Italian companies are the Societa Anonima Benzina Italiana of Naples and the Societa Par l'Industria Italiana del Petroleo of Spezia. The Belgian concern is the Belgian Cracking Co. and its plant is at Langerbrugge.

The first named Italian company, called B. E. N. I. T. for short, has one unit which was fired up for the first time last September. It is operating on fuel imported from Russia. The plant in Spezia consists of two cracking units and is operating on fuel oil brought in from Roumania.

The Belgian plant, which went into operation only two months ago, also is using Roumanian fuel oil as charging stock, although it was designed to operate on tar from low temperature carbonization of coal.

The Belgian plant is quite a novelty, having a capacity of only 300 barrels of charging stock a day. Inasmuch as the plant is reported to be making profits, it would seem to demonstrate the fact that cracking plants are economically adapted to use in refineries which have only a small amount of cracking stock to process, as well as in larger ones.

In countries where the government inclines toward maintaining a monopoly on the production and sale of motor fuel, the cracking plants would undoubtedly be installed by the government. In other countries they might be built by private enterprise, either with or without government subsidy.

Desirable as it would be for a nation to build up such an industry to employ its citizens and supply them with motor fuel in peace time, this might be considered as secondary to the great possibilities such a policy would offer as a measure of national defense. A country could, during peace time, import and store quantities of fuel oil or other charging stock which would make it independent of imports if shut off from its source of supply. It could, in fact, in favorable times build up man-made deposits of oil to provide motor fuel in time of stress.

The last war demonstrated conclusively the enormous importance of adequate supplies of petroleum for a nation carrying on war.

Even a country remaining neutral is likely to suffer partial or total paralysis of its automotive equipment, both on the ground and in the air, if it were dependent on one of the belligerent nations for gasoline supplies or if imports from other neutral sources were cut off by blockade.

This phase of the possibilities of cracking was brought out forcefully by Dr. Gustav Egloff of the Universal Oil Products Company in a paper presented before the World Power Conference in London in October, 1928.

* Universal Oil Products Co., Chicago.

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The building up of a large stock of fuel oil would be perfectly feasible in any country, as Dr. Egloff pointed out.

For instance, he said, "A country the size of France, which consumes in the neighborhood of 400,000,000 gallons of gasoline per year, could accumulate, over a period of time, 100,000,000 barrels of fuel oil. This would furnish, by cracking, 50,000,000 barrels or 2,100,000,000 gallons of gasoline, sufficient for 31,500,000,000 car miles—a five-year peace time supply, and probably sufficient for the requirements of national defense."

To those who regard as fantastic a program providing for building up a storage of 100,000,000 barrels of oil it should be pointed out that there are more than 650,000,000 barrels of oil in storage now in the United States. These stocks have been built up merely in the course of business and without any set program being adopted to that end. In fact the industry would be glad if these stocks were much less.

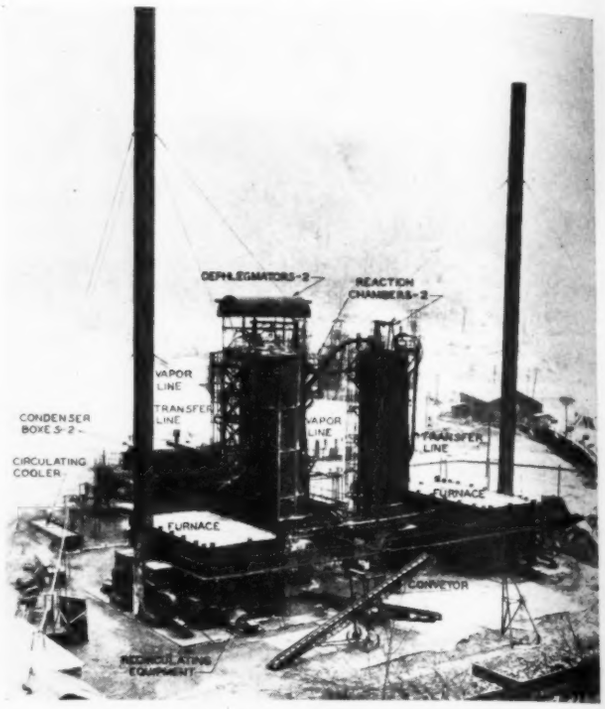
It is pointed out by Dr. Egloff that such oil reserves should be distributed over the country and connected by suitable pipe lines, equipped with pumping stations, rather than be bunched close together. This would make it possible if part of a country were captured by the enemy for the oil to be pumped out of reservoirs underlying it into reservoirs still in possession of the army of the defense.

Assuming that the cost of fuel oil laid down in the tanks, plus the investment involved in constructing the tanks, pipe lines, pumping stations, etc., would run to $2.00 per barrel—figuring 6% on the investment would mean a carrying charge of $12,000,000 a year. It is conceivable that this cost would be far below that necessary to produce and refine oil from natural deposits to make a like amount of gasoline. In peace time the profits from the marketing of gasoline produced would easily justify this expenditure, while in war time, of course, the cost of defense is of no importance.

In case such a program were adopted by a government the money to finance it would be available from the national revenues, while, because of the bearing of such a program on national defense, it is likely that government aid could in many cases be enlisted by private interests taking on such an enterprise.

While the cracking of such fuel oil stocks would yield better than 50% of gasoline, the by-products would be fuel oil or coke, and light distillate suitable for Diesel engine fuel would also be of great value. The cracking process can also be so operated as to produce gasoline, gas and coke only.

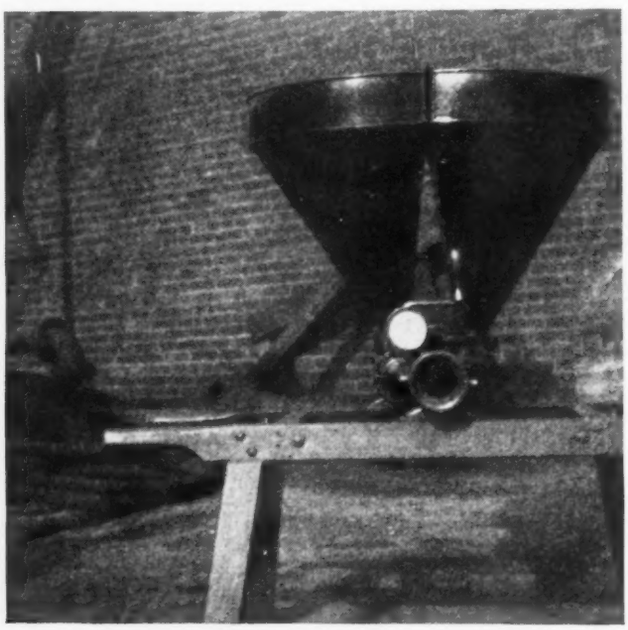
This article is confined to discussion of the applicability of cracking plants to those countries which are without substantial petroleum reserves, because it is taken for granted that the necessity of cracking, in connection with refining operations where crude oil is available is well understood.



A Dubbs unit

There are few successful refining companies today in which they do not have cracking facilities, and the ratio of cracking to other processes for producing gasoline is steadily increasing.

In the United States about 36% of all gasoline produced from the crude in 1929 was produced by cracking.



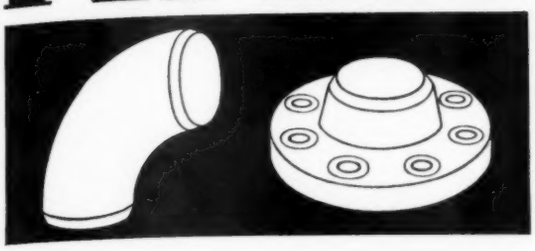
Foam generators used at many refineries.

Portable Foam Generators Used by Many Refineries

THE use of the portable chemical foam generator as standard fire-fighting equipment is believed by some refinery managers to be the most efficient and successful apparatus available for the purpose.

Due to evaporation, deterioration and investment required, the practice of storing two tanks of chemical solutions for fire fighting has been largely replaced or supplemented with the foam generator. This is a portable apparatus which can be readily moved to location of the fire. Two types are manufactured, the one-chemical and the two-chemical. In the latter apparatus two different chemicals are fed into the hoppers and enter into the solution. Two streams of solution are fed into the lines to the oil tank by the generator and mix at the fire. As they mix foam is generated. In the one-chemical generator the chemicals are already mixed in the dry form and fed into the hopper. This powder generates foam in contact with water, and a stream of foam is carried from the generator to the fire.

»»»»» This attractive PIPING



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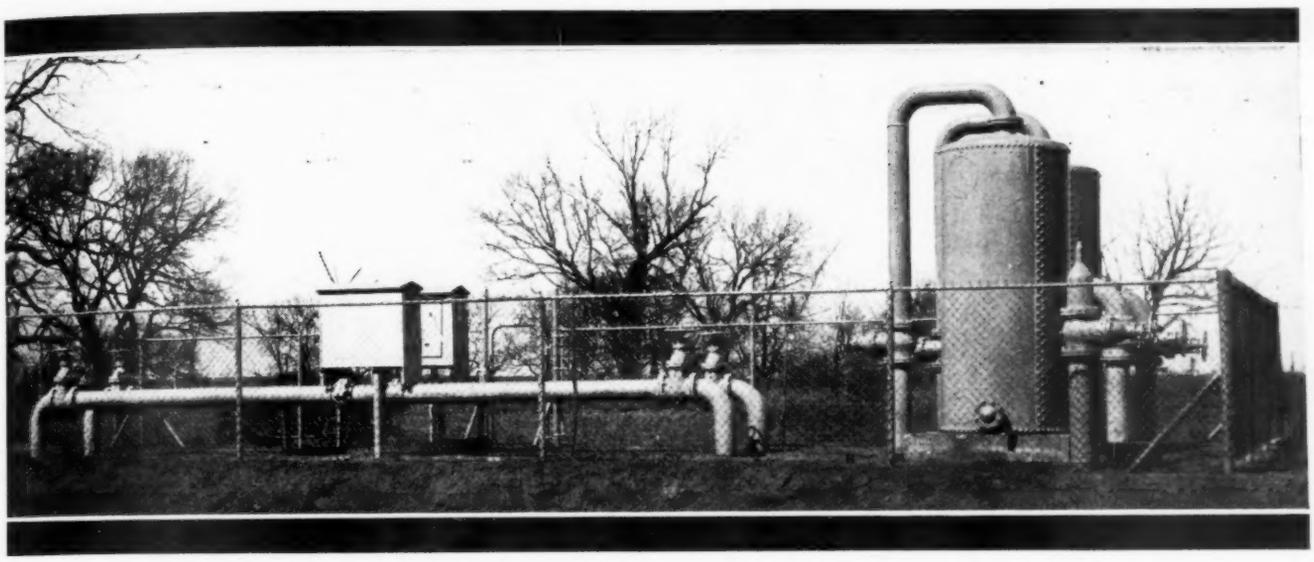

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California's Methods of DISPOSING *of* OIL FIELD WASTE

By

WALTER HUMPHREYS,
Superintendent Waste Water Disposal Company

THE disposal of waste mud, oil and salt water from the oil fields becomes a problem of importance to the oil operators as the fields become closely drilled or encroached upon civilization. Industrial pride invites the proper handling of this waste and public sentiment demands its proper disposal.

The prevailing method of handling this waste is that of forcing it into channels of least resistance. Such practice is being restricted by governmental agencies because of the resulting damage. In keeping with progressive ideas the oil companies in Southern California have been, for the last five years, developing methods for handling this waste. As a result, three major systems and a large number of smaller units have been constructed for the purpose of collecting the waste, separating the oil and mud and discharging the salt water into the Pacific Ocean. The Oil Operators Incorporated, serving Signal Hill in Long Beach, the Waste Water Disposal Company, serving Brea Canyon, Olinda, East Coyote and Richfield; and the Santa Fe Springs Waste Water Disposal Company receiving waste from Santa Fe Springs and Montebello; aggregate sixty-five miles of pipe line, which with a separating plant for each system, have cost the oil companies about $1,000,000. These systems can handle approximately 210,000 barrels of waste daily. One of these systems has been in operation since 1927, the others for nearly two years.

Space will not permit a detailed report of the research, engineering or financial problems envolved in each of the waste water companies. However, a summary of the common salient points will serve to illustrate the problems that are encountered.

A study of the oil fields is made determining the ultimate quantity of waste to be handled for each lease. Information is obtained on the character of the waste, estimating the amount of mud and harmful chemicals in the water, such as acid from refineries that may complicate disposal problems.

With the quantity of material to be handled known, a pipe line system can be planned. The practice in this locality is to extend the pipe line, to be owned by the disposal company, to the main source of supply. In order to relieve the companies of all unnecessary expense, the waste is carried off as rapidly as possible. To this main system the individual companies construct their laterals. If the system is to handle mud, it will be necessary to build an iron line

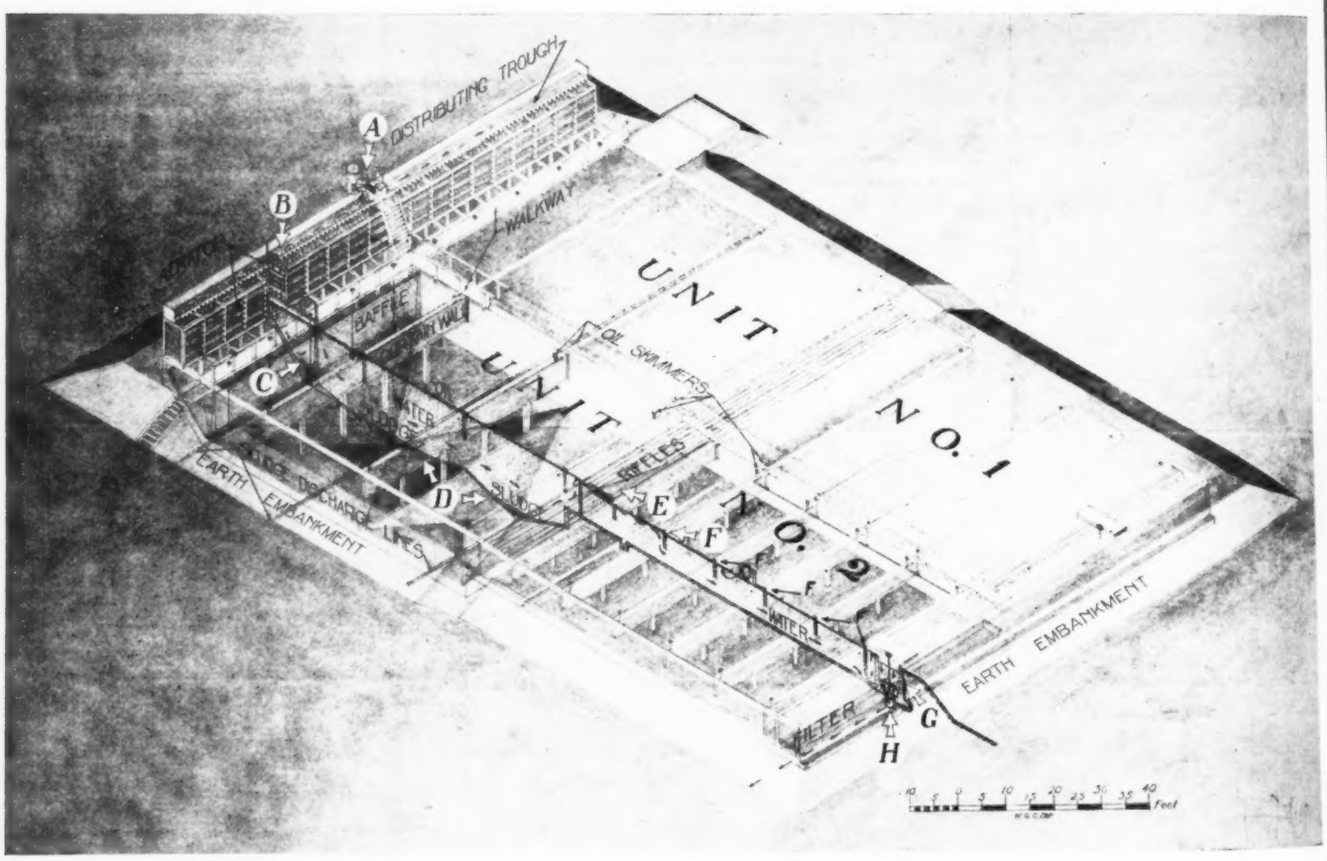
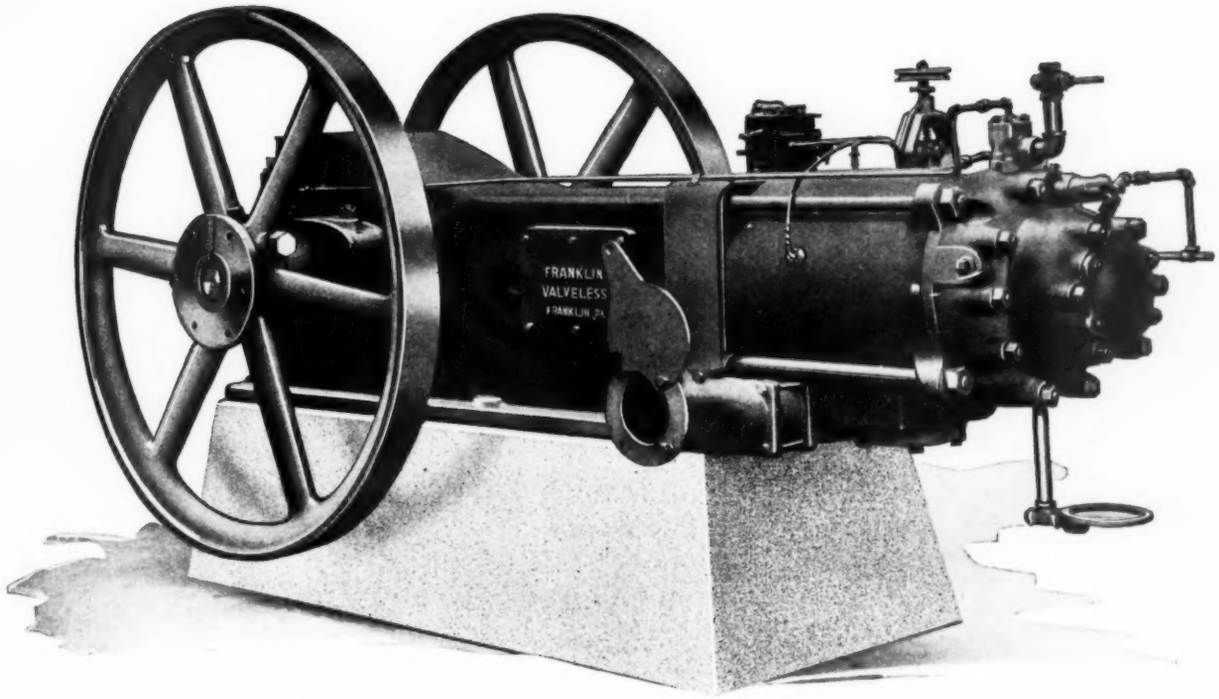


Figure 1

Sketch of modern separating plant. The waste from the field enters at "A" and is distributed through aerators "B" to break the mud from the oil particles. The heavy mud and sand is caught in chamber "C". The water then flows over the baffle wall the remaining mud and sand is removed in sludge chambers "D". At this point 95 per cent of the oil is removed. The remaining portion of the oil is removed back of curtain walls "F" after having been re-aerated over ripples "E". The water is then filtered at "C" before being discharged into the secondary storage pond where it is held for 3 days before being discharged into the ocean. It requires approximately 12 hours for the water to pass through the above plant.



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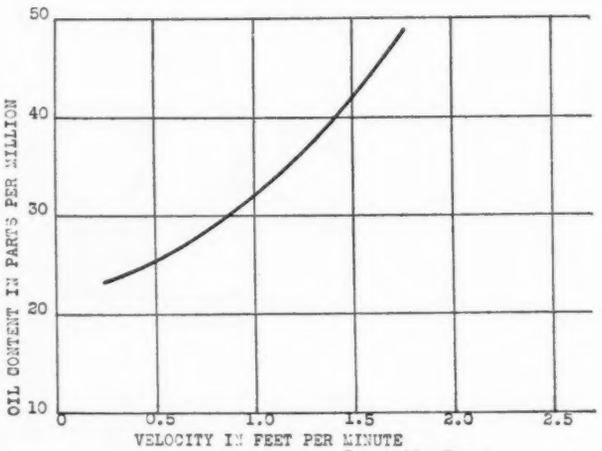
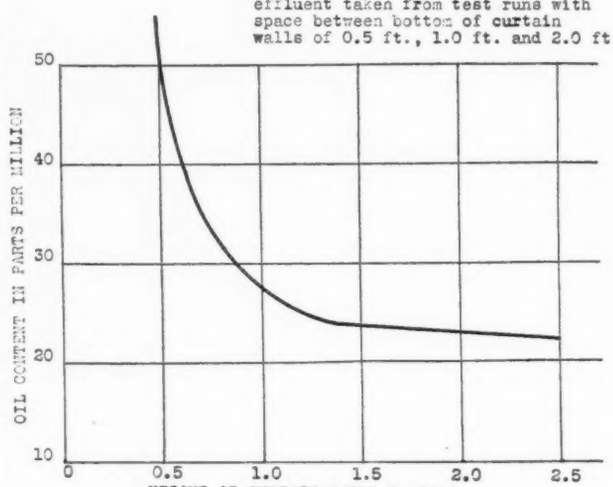
into which the waste is pumped. If only water and oil are handled and the contour of the country permits, a gravity system of clay pipe can be installed. The handling of mud is the source of a great deal of trouble and expense to the disposal companies. If the oil companies will agree to handle their own mud the capital investment and operating cost for any system can be materially reduced. Because of the fact that most of the mud is produced during the drilling period and most of the water during the production period it is important to consider carefully whether or not a system should attempt to handle large quantities of mud.

The disposal plants in California are designed for the purpose of removing the oil from the waste before discharging the water into the ocean; therefore, the simplest, and cheapest method of obtaining this result is desired. The oil industry is familiar with the methods of removing water from oil, but little thought has been given to the methods of removing the oil from the water. No laws have been made or precedents set defining oil-free water. However, the general opinion of those who have studied the results is that water containing less than 100 parts per million of oil will be harmless. The plants in California discharge water that contains less than 30 parts per million of oil.

TEST RUN DATA FROM EXPERIMENTAL SEPARATOR



Composite Curve
Average P.P.M. of oil in samples of effluent taken from test runs with space between bottom of curtain walls of 0.5 ft., 1.0 ft. and 2.0 ft.



Composite Curve
Average P.P.M. of oil in samples of effluent taken from test runs of 0.5 ft., 1.0 ft., and 1.5 ft. per minute, linear velocity.

Observation and experimentation on oily waters reveal that certain elements effect the separation of the oil from the water. These factors may be briefly stated as follows:

Oil separates more readily in warmer waters.

Certain waters either because of chemical or physical characteristics retain oil particles longer.

The lighter the gravity of the oil the more readily it rises to the surface of the water.

The longer the period of retention the more thorough will be the separation.

Algae growth in the waste becomes coated with oil particles which will remain in suspension for many days.

Grains of sand embedded in drops of oil will settle, causing poor separation.

Weather conditions (wind and rain) will carry oil particles through the plant before separation can take place.

Only the temperature and quantity of the waste and character of the oil are given a great deal of consideration in the design of the California plants.

Ninety per cent of the oil will rise to the surface if the waste is comparatively quiet for one hour. The removal of the remaining ten per cent is the problem that has caused most of the study and experimental work to be carried on.

If the waste contains no mud or algae, has a temperature above 90 degrees F., and the oil contained therein has a

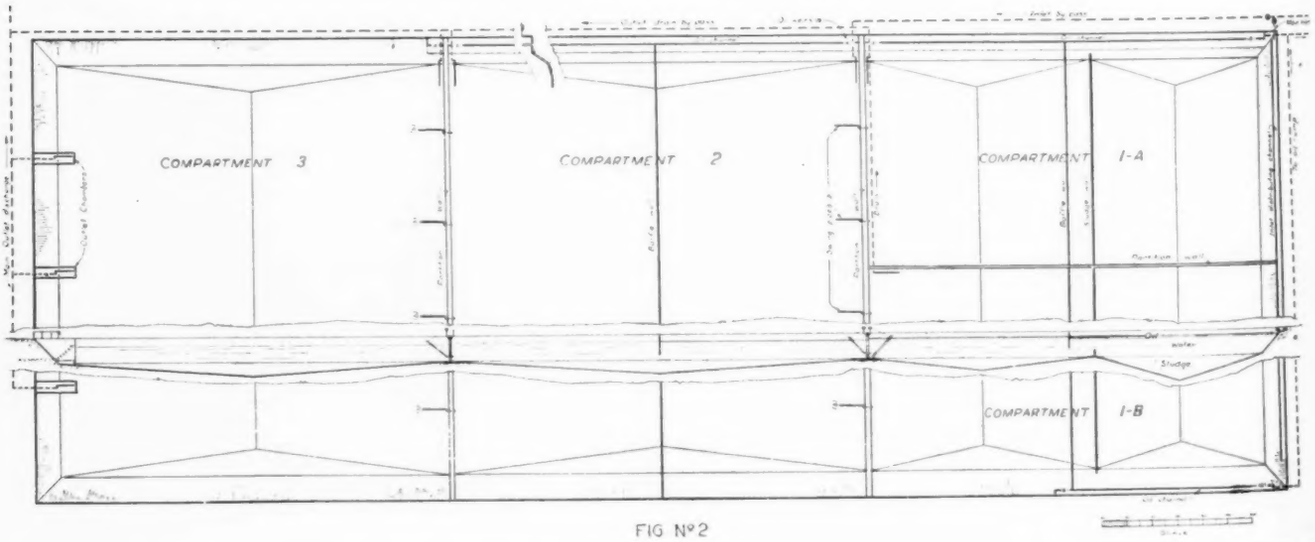
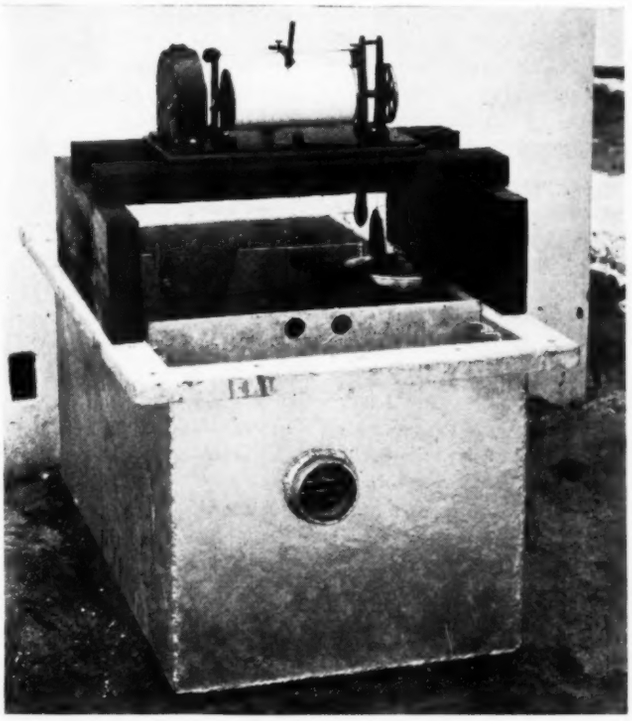


FIG N°2

gravity above 20 degrees A. P. I., the design of the plant is simple. Such a plant would be approximately ten feet deep, have four baffle walls and be of sufficient length and breadth to give a velocity of one-half foot per minute and a retention period of two days. The discharge from this plant would probably contain less than 50 P. P. M. of oil. As very few oil fields will deliver a waste of this type, additions to the plant are necessary to overcome the variable character of the supply.

The best available engineering advisors secured from the oil companies in California directed experimental plants and made tests or consulted government reports of patented processes. They finally adopted a design embodying the principle of gravity separation, adding such features as aerators or agitators, curtain walls and baffles, sediment chambers and filters.



Weir box and recording meter which are placed at all connections of the operator's lateral to the disposal company's system. This type was selected after weeks of experimenting with many devices.

Observation and experimentation indicate that certain factors aid in the rapidity or thoroughness with which the oil is removed.

The waste should pass through water several times, the depth of which should be around eight feet.

The effectiveness of separation is more pronounced in slowly moving water, one-half foot per minute being the ideal velocity.

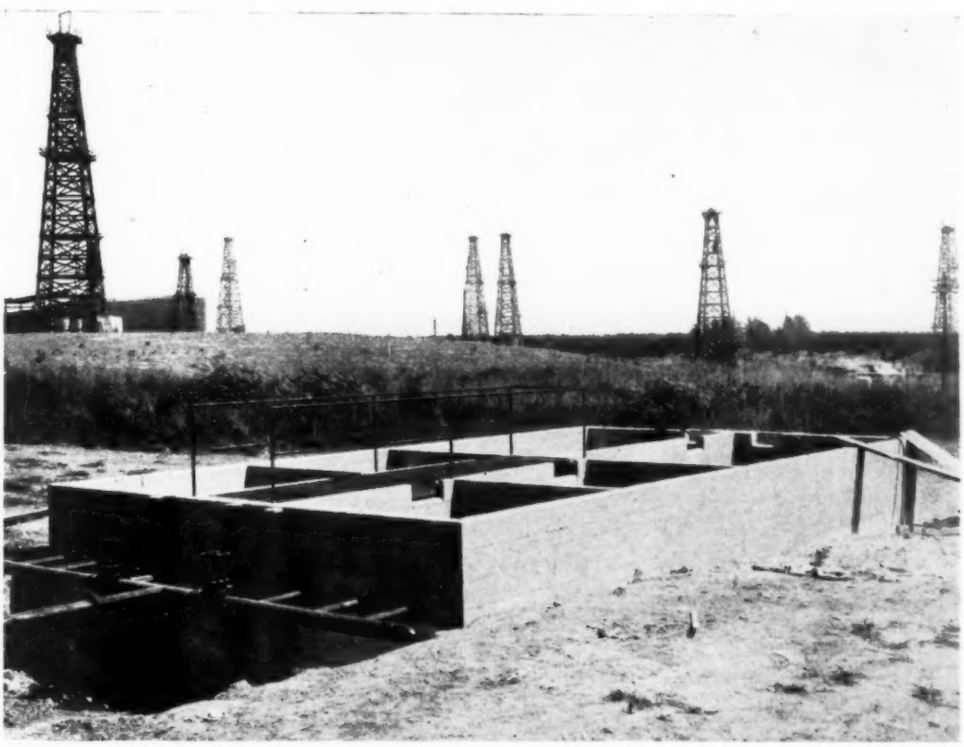
Aeration or agitation of the waste aids in breaking the sand particle from the oil drops. On the contrary, agitation of waste containing algae retards its separation.

Partition walls and baffles assist in proper circulation and in confining the separated material.

Filters aid materially in removing the oil and greatly reduce the retention time. Excelsior filters have been found the most practical. The filters used in the plant represented by Figure 1 have a capacity of twenty barrels per cubic foot per day and require renewal about every six weeks.

The longer the retention period, the cleaner will be the discharge from the plant. Seven days is sufficient to clean almost any waste. This period of time may be reduced, depending on the number of features mentioned above that are added to the plant.

The discharge of the oil-free salt water from the skim-



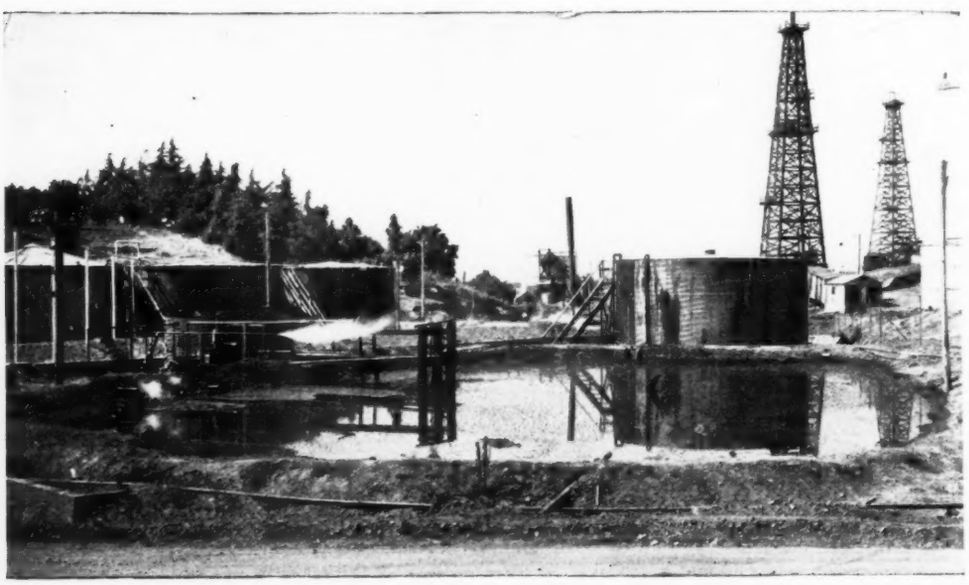
A modern collecting basin replacing the old sump hole. These are built on the operator's property for the purpose of collecting waste water and oil. After the bulk of the oil has been skimmed off, the waste is discharged into the disposal company's system.

ming ponds is as important as the removal of the oil. Saturation of valuable agricultural lands or pollution of surface or underground water supplies should be guarded against. In California a large portion of the total cost of the systems is spent in piping the discharge to the ocean to prevent any possible contamination of the land or fresh waters.

The method of financing the construction and operation of the first system was that of assessing each company an equal sum per well for the capital investment and a yearly tax per well to cover the operating costs. It becomes apparent, however, that all wells do not produce the same amount of water, nor is the well the only source of supply of waste material. The later method of financing, while not as simple as the first, is by far more equitable. Under the new system each company is assessed according to the use of and the amount of waste handled by the disposal company. It will be seen that a company pays for only that portion of the system which it uses on a pro-rated basis. This method of calculating costs required measurement of all waste discharged by each operator into the system. For measuring the discharge, Weir boxes with recording devices are installed at each point where a company makes a connection to the waste water company's lateral. The initial assessment is based on the estimated use. The subsequent assessments are based on actual use and are adjusted yearly.

All plants are operated under a non-profit basis. The management of the systems is conducted under a board of directors selected from the member companies. The oil reclaimed from the waste is treated to remove the water contents and either sold to one of the oil companies or to road or fuel oil buyers. The revenue obtained is applied to reduce the operating assessments.

The operating and construction cost of the three systems mentioned cannot be used as a comparison of efficiency; construction and operating conditions vary too greatly. For example, the Oil Operators, Inc., and the Santa Fe Springs Waste Water Disposal Company handle considerable mud; they also receive a large quantity of oil. The Waste Water Disposal Company handles very little mud and ninety per cent of the available oil is reclaimed by the individual companies on their leases. The Santa Fe Springs System has constructed a long pipe line to the ocean. The Oil Operators, Inc., have practically no discharge pipe line, their plant being built near the ocean. The Waste Water Company pays twenty-eight per cent of its gross operating cost to the county for use of its drainage system. An interesting feature in connection with the Oil Operators, Inc., is the fact that the water contains sufficient iodine to make it profitable for extraction. A private corporation extracts the iodine, paying to the Oil Operators, Inc., a substantial revenue for the right to use their discharge water.



The old sump hole waste disposal system now being abandoned. During the rainy season the earth walls would break or overflow, causing damage to adjacent property.

The table at the bottom of this page gives a comparison of some of the important items involved in the handling of waste water through the three major systems in Southern California.

The operating of these disposal plants is rendering a real service to the community in safeguarding the public interest by the proper handling of oil field industrial waste.

The disposal of oil field waste may be considered as following the history of other industrial and sanitary waste. Step by step, conditions arise which compel improvements to be made. The waste disposal plants are still in their experimental stage. No doubt the near future will see more efficient plants.

Name of Company:	Oil Operators, Inc.	Waste Water Disposal Co.	Santa Fe Springs Waste Water Disposal Co.
Average barrels of waste water handled daily	80,000	11,000	70,000
Capacity of plant, barrels daily	100,000	20,000	90,000
Oil reclaimed, barrels daily	300	70	300
Estimated cubic yards mud received daily	150	1.5	50
Time of retention of water, days	10	6	3.5
Amount of oil in discharge water, average	21 P.P.M.	13 P.P.M	6 P.P.M
Gravity of reclaimed oil	20° A.P.I	15° A.P.I.	25° A.P.I
Temperature of incoming water	120	82	130
Total length of pipe line	10 Miles	23 Miles	30 Miles
Capital investment	$300,000	$194,000	$487,000
Gross operating cost yearly	90,000	23,000	46,000
Net revenue yearly	80,000	15,000	21,000
Net operating cost	10,000	8,000	25,000
Net operating cost per barrel of waste	.0003	.0036	.00133
Number of companies served		13	33
Number of companies in field served		18	35
Type of system	Pumping	Gravity	Pumping
Type of plant	Large earth ponds only	See Fig. 2	*Note

*Note: Primary treatment 3 units as shown in Fig. No. 1. Secondary one large pond with 3 days capacity.

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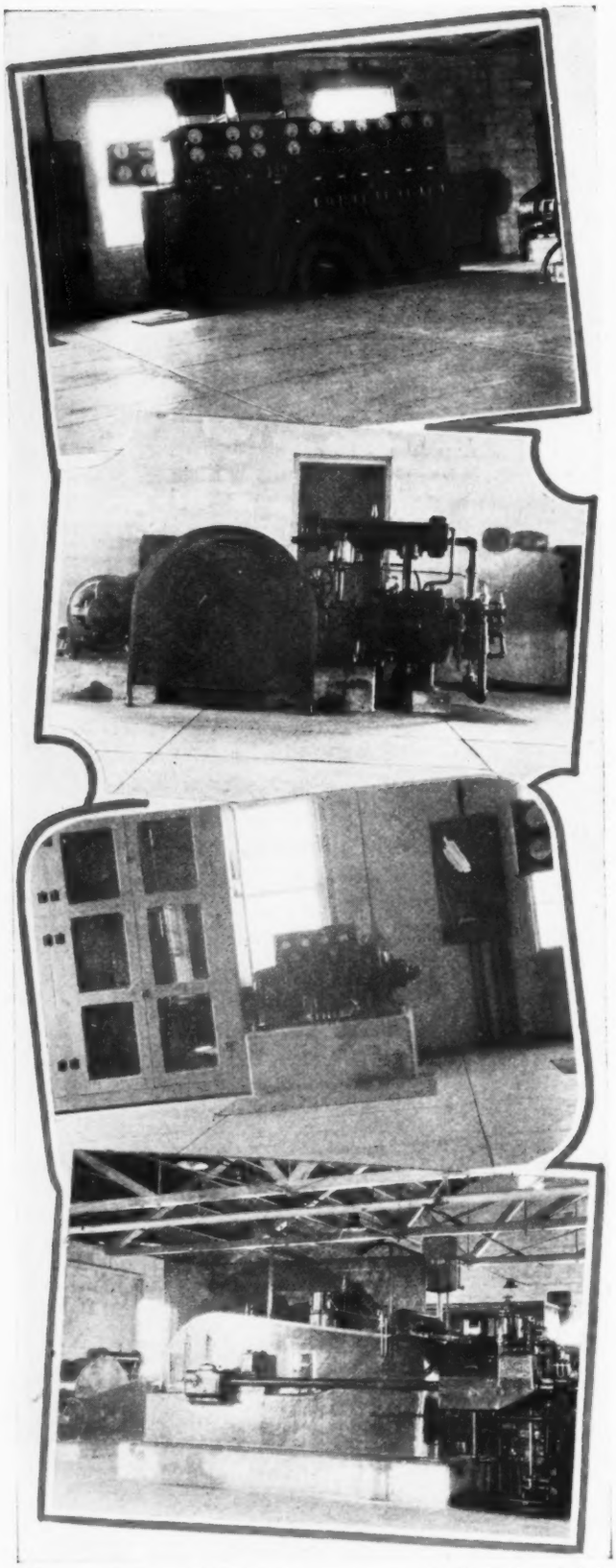
Empire's Petrolia Compressor Station

Has Latest Type Equipment



Top to bottom — Switchboard; compressor with flywheel and belt guarded; motor-driven generator for charging ignition batteries; one of the two 190-horsepower engines

ONE of the most complete auxiliary units along the Cities Service Gas Co.'s expansive main line system is at the Petrolia station in Kansas, which, incidentally, is now comparatively old in service. The auxiliary equipment is adequately provided with guards and safety appliances. The main equipment consists of two 190-horsepower twin 18 by 20 engines direct connected to 150-K.V.A. 60-cycle, three-phase, 480-volt A. C. generators. Energy developed by these machines is used for station and townsite lighting as well as for driving the centrifugal water-pumping units.

It is station practice to alternate each week in operating the two units. While one unit is shutdown the station engineer checks it to make sure it is in proper condition and ready for service.

The switchboard is a 60-cycle, 480-volt board built in five sections and equipped with a voltage regulator. On the same side of the wall with the switchboard and at the end of the building are the ignition batteries for the 1,000-horse power engines in the station. These batteries are charged with a motor-driven generator set on a concrete block foundation on the station floor.

Both of the 8½ by 4½ by 9 air compressors are motor-driven and are located along the walls opposite the two gas engines, and the air storage tanks are located outside of the building. The starting mechanism for all of the electrical equipment is of the latest type.

The centrifugal pumps handling the cooling water for the engines are so connected that they can pump directly into the reservoir or directly to the engines. The smaller pumps handle the domestic water supply for the townsite cottage and pump directly to an elevated tank. All of the water pump suction lines have been re-designed so that all suction lines are now flooded.

Another feature connected with the operation of this auxiliary plant, which is unusual to most compressor stations, is the installation of a calorimeter. This installation automatically obtains the b.t.u. content of the gas going through the discharge lines, and automatically records it on 24-hour charts which are used in connection with contracts for industrial gas consumers.

The building for the plant is constructed with concrete blocks, and the roof built with sheet metal. The rafters are frame and braced with steel tie rods. The floor is kept neatly painted to improve lighting as well as aid in keeping the plant more attractive and clean.

The same measures taken for safety in the main station are carried on to the auxiliary plants. All of the flywheels and belts are covered with steel wire guards. Tools are kept on racks on the walls or in a box out of the way. Piping and wiring are in conduits and the open area in the floor leading to the water pumps is protected by guard rails. Only that which is absolutely necessary to plant operation is kept in the building and consequently the floor is not cluttered with unnecessary material.

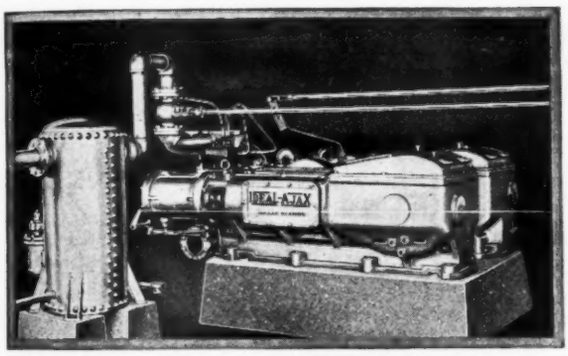
The engineer in charge helps in making the station site more attractive and members of the auxiliary plant crew help in keeping the grounds around the plant in a neat condition.

Piston Type Valves Give IDEAL-AJAX New Power

IDEAL-AJAX Roller Bearing Engine in the St. Louis, Okla. Field.

IDEAL-AJAX

ROLLER BEARING STEAM DRILLING ENGINES



Latest Model IDEAL-AJAX Twin Roller Bearing Engine with Large Capacity Steam Separator

FOR over fifty-three years AJAX and IDEAL-AJAX Engines have been stepped-up with features that might be compared with the improvement in locomotive engine design and practice. The newest IDEAL-AJAX, for example, has piston valves with Locomotive Type Drain Cocks operated from the derrick.

AJAX and IDEAL-AJAX Engines account for about 70% of all steam drilling operations. This development is logical with over a half century behind AJAX standing as the largest manufacturer of this type of equipment in the world.

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Problems Encountered in Gas Line Operation *in* Winter

By D. C. WILLIAMS,
Gen'l. Supt. Kansas-Osage Gas Co.

DURING the early part of 1922 the development of the Burbank field in the Osage Nation had reached the point where there were several million cubic feet of residue gas remaining as a surplus after all gasoline plant and lease operations. The western half of the Burbank field is located on one of the gas leases of the Kay County Gas Company and the Osage Indian regulations provide that the surplus residue gas is the property of the gas lessee.

The natural gas industry knew very little about handling residue gas at this time, since it had been utilized by gas pipe lines in only a few cases and then only in small quantities.

A gas booster station was constructed with a capacity of four million cubic feet daily and during the winter of 1922 and 1923 was operated to capacity; however, there was also about four million cubic feet daily of gas produced from combination wells (wells producing both gas and oil and operated under sufficient back pressure to deliver gas into the pipe line), which was connected into the Kansas Osage Gas Co. eight-inch pipe line approximately one-half mile from the discharge of the booster station. No trouble was experienced in handling this mixture of residue and combination well gas during the winter.

Upper—A gas line drip ready for installation. Lower—Interior of a gas booster station.

The following summer the combination wells had been depleted and the volume of surplus residue gas materially increased. The capacity of the booster station was increased to eight million cubic feet daily and the full requirements of the pipe line were supplied with residue gas. On the first cold day, a freeze occurred in the pipe line about one and one-half miles from the booster station where the pipe line crossed a small creek. A drip had been installed in the line just across this creek and just before the pipe line started up a small hill. The freeze was knocked out by firing the line; however, another freeze formed in the same place the next day. This freeze was forming within twenty feet of a drip and this drip had successfully removed the condensate the previous winter. A return flue brick line heater was constructed about 20 feet from the creek, which prevented any further freezing in the creek.

Three drips had been installed in the pipe line at the time it was constructed in the first three miles, and the condensate which was removed from the drips was gasoline with a small amount of water. As the weather grew colder the freezing continued, creating a serious condition. A freeze would form in the line in a downward grade just as readily as in an upward grade. It was necessary to locate the freeze and fire the line to remove it, since service to domestic consumers had to be maintained through the line.

Since no trouble had been experienced the previous winter when a mixture of residue and combination well gas was handled, it was decided that it might be possible to eliminate the freezing by lubricating two or three barrels of crude oil daily into the pipe line, since the gas produced from the combination wells had carried a small amount of crude oil. A small amount of the condensate was removed from a drip and mixed with some crude oil which immediately formed an emulsion and showed that it would not be possible to use this method of preventing freezing.

It was then decided to lubricate alcohol into the line in an effort to prevent freezing. Because a part of the alcohol could be recovered in the drips the expense of this operation

would not be prohibitive. A freeze which had formed and had reduced the volume of gas passing the line to four million cubic feet daily was located, and two drums of alcohol lubricated into the line within 20 feet of the freeze. The alcohol had no results on the freeze, which continued to grow worse. As an experiment, about one hundred pounds of salt mixed into a heavy brine was lubricated over this freeze with negative results.

By this time about five line heaters had been constructed at critical points and it was found that this resulted in preventing freezing at these points but that the freezing would occur a little farther down the line. Since the line heaters were only delaying the point at which the freeze would occur, the use of them was discontinued.

In one instance a drip reservoir, which was five feet in the ground, froze and it was necessary to remove it. When uncovered the reservoir had about one foot of frozen earth attached to it. An attempt was made to get a sample of the condensate contained in this reservoir into our laboratory, and since no high pressure container was available, one was made from a 2 by 10 nipple and two 2 by ¼ reducers. The container was filled and hauled to the company field office in a car and upon arriving was covered with a cake of frost. A test gauge was put on the container and the pressure found to be about 600 pounds, which due to the type of container was released. Two 2000-pound test welded containers were located and filled with the condensate and packed in ice and salt and brought to the laboratory at Ponca City. Upon arrival they were found to be empty.

It was found that all of the freezes occurred in the first three miles of the line and pressure connections were made at about one-quarter mile intervals, with two bell holes open between each. By a very close observance of the differential on the master orfice meter, it was found the men could detect a freeze forming, and by taking pressure readings along the line the freeze could be located before it seriously affected gas deliveries. It was necessary to place the fire within a few feet of the freeze in order to thaw it out. After the freeze was located in a quarter-mile section, it could be exactly located by placing a sharpshooter on the pipe line at the bell holes and "listening out" the freeze.

The hot and cold of it. Upper—Crew making gas line repairs in a swamp in midsummer. Lower—A field man's car stuck in the snow.

The eight-inch line was constructed with couplings and the normal line pressure was about 300 pounds. It was often necessary to place a fire very close to a coupling and the couplings were protected by packing them in a thick "mud ball".

At times it was practice to shut the line out at night and part it, and then blow the ice out. The ice was a milky white color and very light in weight. We found that a small piece of the ice would require several hours to melt when placed in the sun, also that it would burn like a pine knot. A piece of ice about four inches square when allowed to burn would leave about one-half ounce of water in the vessel.

The gasoline plants in the Burbank field were beginning the use of fractionators at this time. The undesirable vapors discharged from the fractionators were put into the residue gas. It was found that this greatly increased freezing and it was necessary to discontinue this practice.

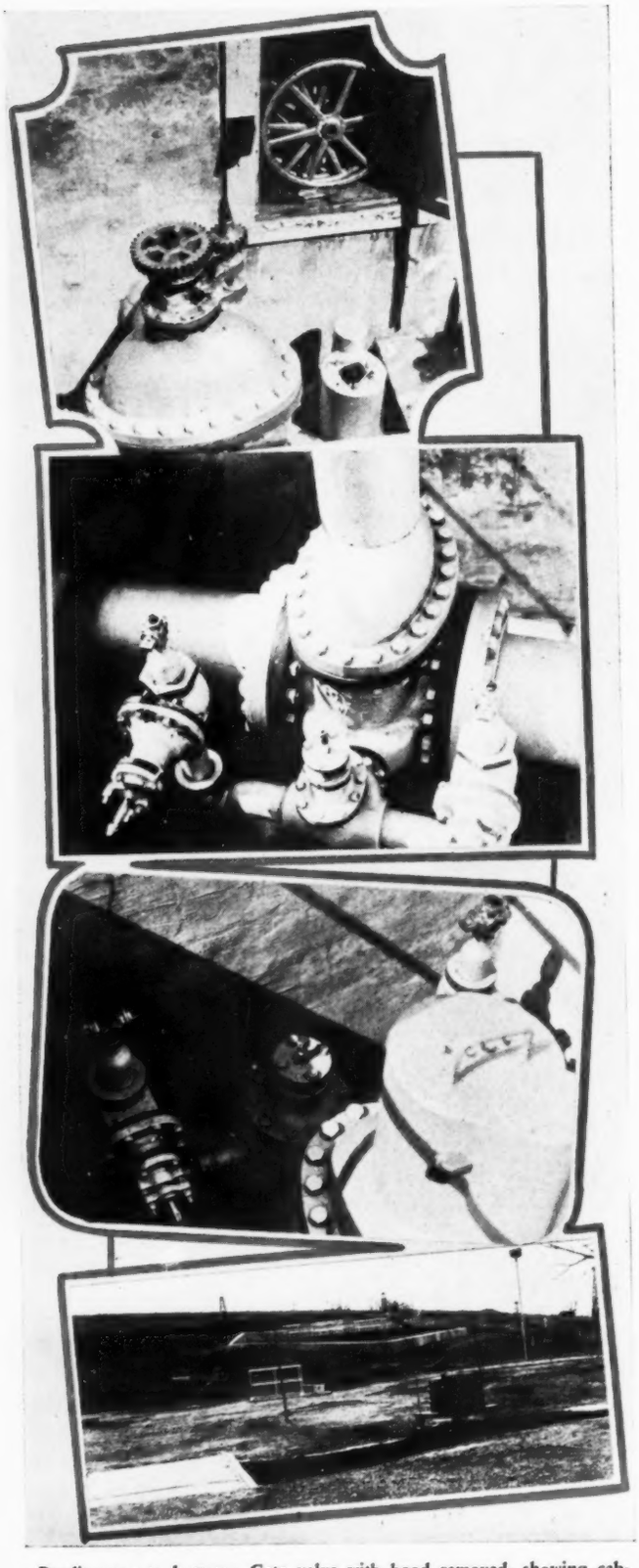
During the next summer additional cooling equipment was installed at the booster station, so that the temperature of the gas was reduced as low as possible, since experience had taught that the freezing was caused from a combination of water and a very wild gasoline. As an additional precaution several additional drips were installed at points where freezing had occurred. It was found that atmospheric conditions and temperatures controlled the freezing points. The volume of condensate which was recovered from any of the drips was very small, however, only a small amount is required to start a freeze, which when formed to a point of causing a drop in pressure across the freeze would set up a refrigerating plant which would complete the freeze in a very short time. It was therefore necessary to install a great many more drips than would have been required in handling natural gas. It was also observed that the greater the velocity of the gas through the pipe line, the greater the number of freezes. It would no doubt be money well spent to make the first three miles of pipe line on the discharge of the booster station larger than required. In handling residue gas, the following factors are very important:

(1) Efficient cooling equipment at booster station; (2) A Sufficient number of efficient drips properly placed; (3) Elimination of fractionator gases from the residue gas; (4) A pipe line of ample capacity and if possible surplus capacity.

The first three of these when put into practice did not eliminate freezing, but did cause a material reduction in the number of freezes. The past few years have observed the expansion of natural gas systems to many different parts of the country, necessitating much longer lines. The continuation of this policy will undoubtedly result in much additional information regarding winter operating problems.

Gas Company Finds Hoods Useful for

Guarding Gate Valves Against Tampering



Reading top to bottom—Gate valve with hood removed, showing cabinet for the wheels built into wall; gate valve with hood in position; concrete retaining walls built around manifolds.

AT its Crawford junction, where the frequent switching of gas is necessary, the Oklahoma Natural Gas Corp., has designed a gate valve layout that is useful in the promotion of safety. The wheel of each valve is removed and locked in a cabinet built in the concrete wall and the stem is protected by a hood. This not only prevents someone curious to "turn the wheel" from doing so, but also gives added protection during storms which are likely to cause trouble.

As shown in one of the accompanying photographs, the hood used to cover the valve stem is made from a piece of pipe with a disc welded in the top. The handle is also welded to the top of the hood.

After the wheel is removed the hood is slipped over the stem and a key inserted in the slots cut in the hood. A hole is cut in one end of the key and through this the hood is locked over the stem. The company's identification number of each valve is painted on the hood as well as the valve to make doubly certain of the operator opening or closing the right gate.

When excavations were made for the gate layouts a hole was cut in the wall large enough to accommodate all of the wheels for the valves at that point. A frame door was used to cover the front of the wheel cabinet and this is kept locked. To protect the locks from the weather, shields made of leather are fastened over the top. Each employe working at or near the junctions has a key to all of the locks.

Another operation feature of the junctions are the by-pass valves on each gate. These are used whenever the gate has to be opened against high pressure on one side and zero on the other. By opening the by-pass the pressure is equalized and the gate is easily opened.

Each junction is a model in neatness and attractive appearance. All of the valves and exposed pipe are painted to reflect the rays of the sun and each gate pit is well drained and equipped with painted ladders made out of old pipe.

Crawford junction is located on the side of a long sloping hill coming up from a valley through which a small but sometimes turbulent stream runs. Another small ditch cuts directly through the site and this is bridged with a steel bridge also made of old pipe.

Concrete retaining walls have been built around the meter house and around the manifold to prevent the dirt from washing away during rainy weather. Carrying safety features further, the company has built railings around all of the openings which are not protected with a manhole covering. Placards placed in conspicuous places give warning of nearby dangers.

The site is always in a tidy condition around the risers from drips. A frame elevated platform is located near the drip riser which will easily accommodate three lube oil drums. The condensate from the drips is stored in the drums and later hauled away.

During the summer months each junction blooms with an abundance of flowers and shrubs. The grass is kept close cropped and free of rubbish. Because the turbulent stream in the valley sometimes floods the site, a flood water relief ditch has been built around the slope to carry off the surplus water. This not only protects the mechanical equipment from water, but the site from flood water.

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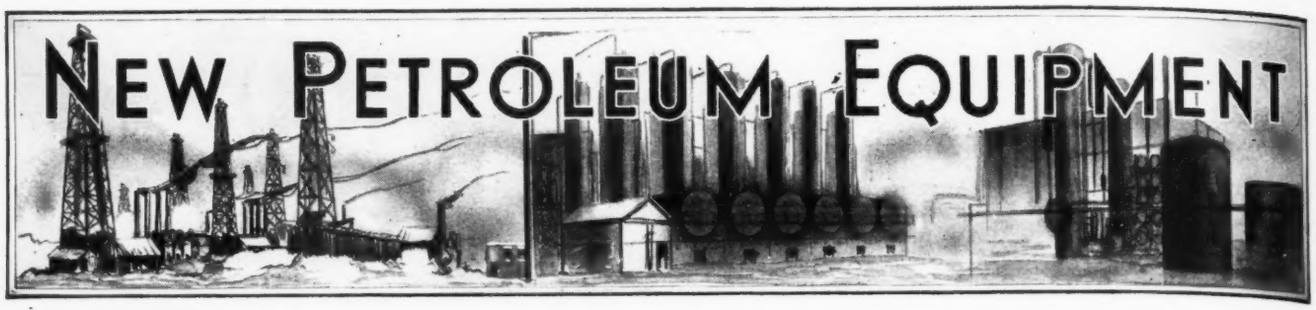


Parkersburg-Superior Oil and Gas Separator

IN SERIES with the production line, the new Parkersburg-Superior oil and gas separator, manufactured by Parkersburg Rig & Reel Co., Parkersburg, W. Va., provides a means of extracting dry gas for use or market. This separator takes the gas from the line and allows the oil to pass on its course to the tank. It also functions as a settling tank to separate water from the oil and remove sediment.

According to the makers, the gas man can readily see the possibilities of this separator for handling "drowned" gas wells, and it is efficient as an automatic drip because water can be siphoned through the device and the gas removed.

The separator is extremely simple and its operation entirely automatic. The line from the well, either flowing or pumping, is attached to the tangent-directed connection near the top of the separator. The fluid takes a whirling motion and passes down over a series of baffles, thoroughly breaking up the contents to release the gas which, without a separating device, too often is lost by evaporation later. The gas passes through perforations provided, and is carried out through the field line at the top.

Sediment and water are drained off from the bottom. The manhole at the side provides entrance for occasional inspection and cleaning.

The interior construction of the separator is of copper bearing steel. The valve is of brass and is non-sanding; these materials being selected to resist the corrosion hazards to which this type of equipment is subjected. There are but three moving parts.

This separator is said to be in use by a number of the major producing companies. It is made in a number of different sizes and capacities, with working pressures up to 1,000 lbs. maximum.

The illustration shown is of the D-1 Model, which has a daily fluid capacity of approximately 5,000 bbls., and is constructed to withstand pressures of 200 to 300 lbs. In some places, these separators have been installed in batteries to permit the removal of gas from larger volume production. Being an individual unit, it is readily installed in any arrangement. Many may be used on the derrick floor, serving a single well.

The Arco Company Builds Large West Coast Plant

THE Arco Company of Cleveland has selected Los Angeles as the location for its new paint plant to serve the western, Latin American and the Oriental trade.

A survey of western and export business conditions made by S. D. Wise, president, and S. D. Weil, vice-president, was responsible for the decision to construct a West Coast plant.

The rapid industrial growth of California with the greatly increased volume and variety of manufactured products being made in the West, prompted the directors of the Arco Company to locate a plant on the Coast to take care of this increased volume.

Louis Allis Co. Has New Distributor

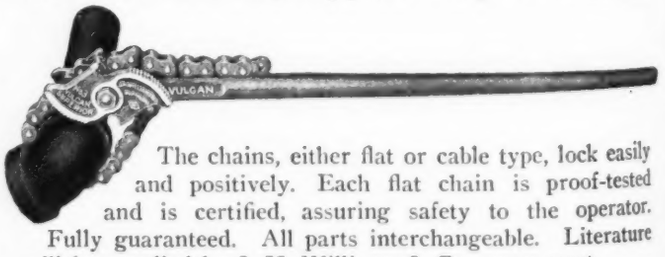
THE Louis Allis Co., Milwaukee, Wis., announce the appointment of Electric Motor Co., 215 B East Archer, Tulsa, Okla., as exclusive agents to handle the Louis Allis line of open type, totally enclosed and "explosion proof" motors for the petroleum industry in Oklahoma and southeastern Kansas. The new motor company is under the direction of W. Woobank, who will be assisted by R. C. Chenoweth. A stock of motors will be carried by the Electric Motor Co., which was awarded the contract voluntarily surrendered by Nelson & Co., because of the press of their multiplicity of other lines.

Williams' New Pipe and Fittings Tongs

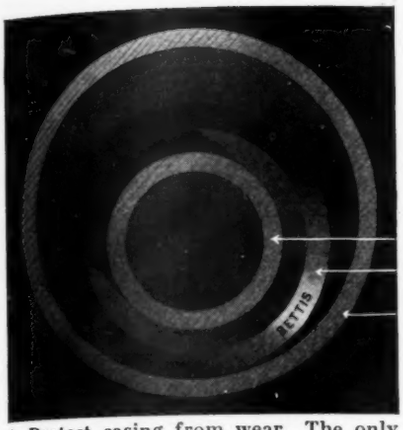
J. H. WILLIAMS & CO., Buffalo, N. Y., have just introduced their "Vulcan Superior" Chain Tongs for universal service on both pipe and fittings—two tools in one. Two tools as commonly used (one for pipe and one for fittings) are unnecessary, the makers state.

The "V" recess in the jaws assures quick and positive grip on fittings. Since "Vulcan Superior" can be used instantly on either pipe or fittings, they are said by the manufacturer to be the perfect tongs for steamfitters. Other claims made by the manufacturer are: No stopping to alter the tool itself; no parts to lose; equally efficient, without any change whatever, for both pipe and fittings service.

It is claimed "Vulcan Superior" is the only chain tongs on the market with reversible pipe and fittings jaws. When the teeth first in use wear, simply turn the jaws end-for-end.



The chains, either flat or cable type, lock easily and positively. Each flat chain is proof-tested and is certified, assuring safety to the operator. Fully guaranteed. All parts interchangeable. Literature will be supplied by J. H. Williams & Co., on request.



62 BETTIS REASONS

1. Protect casing from wear. The only contact between pipe and casing is the rubber.
2. Protect collars. Bettis Protectors have a larger diameter, preventing abrasion on collar.
3. Protect tool joints for the same reason.
4. Protect drill pipe from fatigue.
5. Help drill straighter hole because the Protectors act as a guide.
6. Better control of drilling on account of reduced friction, enabling the driller to know with greater certainty what the drill is doing.
7. Increase life of drilling string because of less stress, less vibration and practically no abrasion.
8. Reduce twist-offs and fishing jobs by relieving drill pipe of excessive strain and permitting more accurate control.
9. Insure better water shut-off. The casing is not severely pounded and weakened.
10. Faster drilling by elimination of excessive friction and through better control.
11. Total cost of well is less.
12. Later pumping costs reduced because the well is drilled straighter, affecting pumping costs.
13. More flush production because of faster completion, especially desirable in offset drilling.
14. Ultimate life of well is increased. The casing is not worn thin; water intrusion is delayed.
15. Less strain on drilling equipment results in longer life and less depreciation.
16. Least vibration by reason of rubber contact which absorbs the impacts.
17. A large saving is made in power because less steam or electricity is used.
18. More power is delivered to bit.
19. Less water to pump because less steam is required at the rig on account of power saving.
20. Less tonnage of equipment to transport, such as replacement of pipe, casing, tool joints and collars; important in wild-catting.
21. Salvage value of casing is increased because no appreciable internal wear occurs on casing.
22. The life of brake band lining is greatly increased. The pipe has tendency to float.
23. Protectors serve as float for dropped pipe, and frequently prevent corkscrewing. (There are six authentic cases to our knowledge where pipe dropped 5,000 feet, without damage.)
24. More economical by reason of longer life and lower drilling costs.
25. Less cost of re-threading, due to infrequent replacement of joints and collars.
26. Lower labor costs by reason of less wear and tear on equipment and faster drilling.
27. Breaking out is easier because the tool joints are not bucked together as hard as is the case where Bettis Protectors are not used.
28. Threads on pipe do not gall as much because of the resilient cushion of the Protectors.
29. Protect Kelly joint and sub. The Protectors can be applied to Kelly and sub.
30. Longer life to wire lines on account of less friction when pulling out the string.
31. Less strain on derrick because the load is lighter when pulling out or running in. There is less weight for derrick foundation to hold.
32. Help prevent collapse of stove-pipe because all metal-to-metal contact is prevented.
33. Help prevent seat of stove-pipe from breaking by eliminating excessive pounding of collars.
34. Save top casing. The Protectors are applied to the Kelly joint, thereby saving top joints of casing.
35. Help prevent breakage of cement seat by reducing pounding on pipe. The cement will not crack easily.
36. Safer in drilling out cement plug. The smooth drilling action reduces whipping of drill pipe and insures better job of drilling into same.
37. Less corrosion; no metal is used.
38. No danger in rock bit operation, as no metal is added to hole. The rubber is lighter than the mud and cannot lodge between bit and wall to cause a fishing job.
39. Resistant to oil used in circulation.
40. The rubber serves as an insulator and minimizes magnetism of pipe and casing.
41. Fishing tools are not obstructed because no metal is used. The washover shoe or overshot will push the Protectors ahead. There is no metal scrap to lock or clog jaws of overshot.
42. The Protectors can't fall in the hole and cause a bad fishing job. If for any reason any became disconnected, they would float.
43. The Protectors will not impede circulation; the diameter does not fill the entire hole.
44. No metal to injure workmen. Bettis Protectors are made of seamless rubber (protected by basic patents), and do not embody hinges, pins, knobs, clamps or metal gadgets.
45. Can't ring-cut the drill pipe.
46. Retain original grip on the drill pipe and actually outlast the pipe. The Protectors permit proper expansion over the pipe.
47. No time lost when installing; only a few seconds are required per Protector and even an inexperienced operator can install them.
48. Safest in cleaning out old wells, especially those drilled before the advent of Bettis Protectors. Such holes are invariably crooked or the casing is thin.
49. Necessary for deepening jobs. Conditions in such a well are unknown and no chances should be taken with unprotected drill pipe.
50. Minimum investment in warehouse stocks because of the great saving in pipe, casing, tool joints and collars.
51. Climatic conditions have a minimum of bad effect on Bettis Protectors. They are coated with a protective fluid that makes the rubber highly resistant.
52. Bettis Protectors are the original rubber cushions and have no substitute. They consist of specially compounded rubber, offering a continuous ring of resilient material and greater area of wearing surface.

Bettis Drill Stabilizers

The majority of advantages found in the use of Bettis Protectors are duplicated in Bettis Drill Stabilizers, and in addition the following reasons are offered why your drilling string should be equipped with these Stabilizers.

53. Permit better control of drilling in open formation.
54. Hold pipe in center.
55. Stop whipping above the drill collar.
56. Prevent hinging action of drilling string.
57. Overcome vibration, which usually is greatest immediately above the drill.
58. Drill straighter hole by keeping the pipe in alignment below the casing and in open hole.
59. By stabilizing the pipe the drill cannot follow the line of least resistance and take a wandering course, causing a spiraled, crooked well.
60. Stop excessive wear on bottom collars.
61. Bettis Drill Stabilizers are much larger in size than Bettis Protectors, but allow sufficient room between the wall of the formation and the Stabilizer for circulation of fluid.
62. Prevention of side play and wobble in the string permits higher speed in drilling, better control, which in turn mean a great saving in time, labor and production costs.

FULLY PATENTED

Genuine all-rubber protection—"Best bet yet"

PATTERSON-BALLAGH CORP.
INSURANCE EXCHANGE BUILDING, LOS ANGELES

Texas and Gulf Coast Distributors:
BETTIS SALES CO., 616 Public National Bank Bldg., Houston

Oklahoma Distributors:
BAILEY & BECKER COMPANY, 410 Thompson Bldg., Tulsa

New York Office: 39 Cortlandt St.

Carried in stock at Los Angeles, Santa Fe Springs, Ventura, Kettleman Hills, Bakersfield, Coalinga, Long Beach, California; Tulsa, Oklahoma; Houston and Wink, Texas; Calgary, Alberta, Canada; New York City

BETTIS PROTECTORS AND DRILL STABILIZERS

When writing PATTERSON-BALLAGH CORP. *please mention The Petroleum Engineer*

Martin-Decker Corporation Moves Into New Plant

THE Martin-Decker Corporation recently celebrated the completion of their new plant and offices with an opening party. Approximately five hundred people attended the celebration. The many friends of the concern were very generous and thoughtful with their floral offerings which banked the office with all kinds of bouquets. The shop was decorated for the evening, with flags and streamers of all nations. Dancing was enjoyed on the concrete floor, which had been sprinkled with cornmeal, to the pleasing music of the ten-piece orchestra from the Shell Oil Company's Signal Hill production department. After the dancing which terminated at midnight, the oil-field talent did their share of entertaining by tap dancing, singing and a general display of talent which was a revelation to most of those present. One of the biggest surprises was the excellent display of tap dancing by "Slim" Cassell, Martin-Decker field salesman.

New Martin-Decker Plant

The Martin-Decker Corporation purchased the property outright at 3433-3443 Cherry Avenue, Long Beach, California. Their new factory was built after their own idea, which includes the Spanish stucco office building, consisting of five offices in addition to the general office, reception and display rooms. The factory building is of standard steel construction, and the equipment, which is used for the manufacture of weight recording, measurement and control devices, is of the latest type direct motor driven machinery.

W. R. Martin, President

E. L. Decker, Vice-President

The trade publication, because of its wide availability, is perhaps the greatest instrument for continuing education. The field man and the engineer, regardless of their status in industry or research, stand still when they cease to read the literature of their field.—Selected.

Tucone Bit Catalog

THE new catalog of the Chicago Pneumatic Tool Co., covering the C. P. Tucone Rock Bit, has just been issued, and copies will be sent to anyone making request to the main office, 6 E. 44th St., New York City.

The catalog is a work of art, containing an abundance of illustrations in color, as well as diagrams and drawings showing the work of the bit in operation.

Pamphlet Describing "The Mixitt"

THE Max B. Miller Company, Inc., 501 Fifth Avenue, New York City, is distributing an eight-page illustrated pamphlet describing "The Mixitt." This is a device used in connection with continuous treatment of liquids, for adding automatically the exact amount of reagent required in a continuous process.

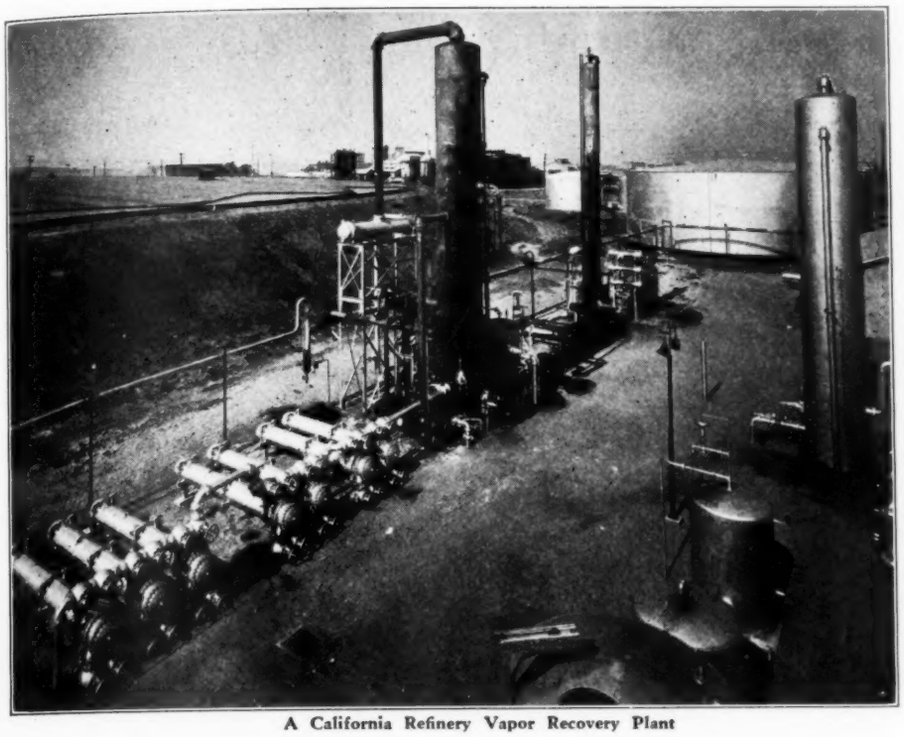
Broderick & Bascom's New Office Building

THE last issue of "The Yellow Strand," house organ of Broderick & Bascom Rope Co., St. Louis, Mo., contains a double-page spread showing the new St. Louis office and administration building which adjoins the B. & B. factory. The photograph on the cover of the magazine illustrates the simplicity, dignity and spaciousness so apparent throughout the building; low, wide, deep and with many windows, every corner must naturally be flooded with sunlight.

Handling Heavy Materials With Electricity

"ELECTRIC Equipment for Handling Heavy Material," is the title of a booklet beautifully illustrated in color, published by the General Electric Co. of Schenectady, New York. It contains an unusually large number of illustrations showing industrial equipment of various nature.

FOR CLEANING



A California Refinery Vapor Recovery Plant

» **Heat Exchangers**
» **Stills**
» **Preheaters**
» **Plant Parts**
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» **Bearings**
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» **And All Heavy Duty Cleaning**

CHARLITE

» » *Heavy Duty Cleaner No. 2* « «

Charlite is economical, efficient and speedy for use in heavy duty cleaning of all kinds around the refinery and gasoline plant. Charlite No. 2 was developed and perfected from a thorough knowledge of the cleaning requirements of the industry, based on years of experience.

Intelligent and expert engineering service for your most difficult cleaning problems may be secured without additional cost. We are prepared to show you that Charlite No. 2 will effect real savings in time, labor and material over other cleaning methods. Write for complete information without obligation.

Manufactured by

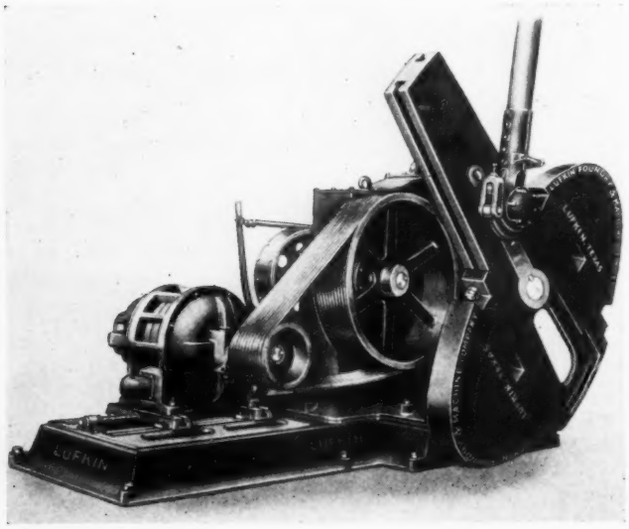
THE CHARLOTTE CHEMICAL LABORATORIES, Inc.

Charlotte, N. C. **New York Office, 50 E. 42nd St.**

When writing CHARLOTTE CHEMICAL LABORATORIES, INC., *please mention The Petroleum Engineer*

Lufkin Announces New Unit

THE LUFKIN FOUNDRY & MACHINE COMPANY of Lufkin, Texas, announce the development of a new unit which employs the new Sykes-Herringbone type of gearing. At the present time production is on two sizes only, namely, standard (5½") and heavy duty (6½"), and the manufacturer states that over one hundred of the new units are now in use.



The Sykes-Herringbone gear used in the new Lufkin Unit is said to be superior in strength, efficiency and silence of operation, due to continuity of tooth contact peculiar only to this type of gearing. This type of gearing also provides the maximum contact for a given width of face and back lash is practically impossible, due to elimination of thrust, the makers state. Bearings in the new Lufkin unit are anti-friction type throughout, with Hyatt roller bearings in the pinion shaft. According to the manufacturer, only the highest grade of material is used in the new unit and a special heat treatment has been developed that will insure the longest life possible to obtain. New equipment has been installed in the Lufkin plant for the manufacture of this unit, the most interesting of which is the special equipment for generating the teeth on the gear and pinion and the special lapping in machine for matching and insuring precision of these units.

The design of the New Lufkin Unit permits the adaptation of any type of prime mover. Already both Oil Field and Star Delta types of electric motors, multi-cylinder and single-cylinder gas engines and steam engine installations have been made.

The Lufkin Company is well known to producers of oil in every important field as the manufacturers of the Lufkin Worm Geared Units, some thirteen hundred of which are now in operation. Other products of this company are the Trout self-aligning pitman, self-supporting samson post, beams, and rod and tubing hoists of various sizes. The Trout counterbalance crank is also used on the new Herringbone Unit.

The March-April issue of the Lufkin Line, published by the Lufkin Foundry & Machine Company, contains full information on the new unit and will be mailed to those interested upon request.

Now Miller Sand Pump Co.

FOR the convenience of their customers and to more closely associate their name with their leading product, Miller Combination Bailer & Pump Co., Sapulpa, Okla., has changed its name to the Miller Sand Pump Co. The products, policies and personnel remain unchanged.

The products manufactured by the company are: Miller sand pumps, Chancellor oil and gas separators, Jiffy pipe clamps and automatic wire line twisters.

New Equipment for Republic Rubber

THE REPUBLIC RUBBER COMPANY, Youngstown, Ohio, has just finished the installation of a new 60-inch by 30-foot Farrel press, the platens of which are solid steel, drilled for steam circulation. It is equipped with two rows of twelve hydraulic rams which operate under 2000 pounds hydraulic pressure per square inch, giving a total pressure of 738,912 pounds on the platens.

The platens are fitted with water cooled ends and have accurately ground surfaces, making it the last word in modern equipment for the curing of sheet products for which it was purchased, the manufacturer states. The total weight of the press is 340,000 pounds.

This press, together with all hydraulic presses and vulcanizers used in the packing department, were installed in the room formerly used for the making of molded goods which of course necessitated the moving of the molded goods presses to new quarters.

The complete renovation of these rooms, together with careful going over of the equipment, has all been done with the idea of increasing efficiency in handling the products and to care for the steady increase in volume of business.

New Tube-Turns Distributors

APPOINTMENT of The E. F. Keating Company, 452 Water Street, New York City; Himelblau-Agazim & Company, 30 North Dearborn Street, Chicago, Illinois; and Stewart Machinery Company, Buder Building, St. Louis, Missouri, as distributors is announced by Tube-Turns, Incorporated, Louisville, Kentucky.

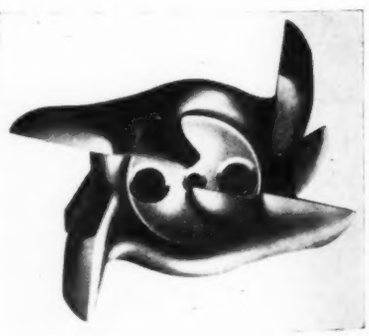
Each of these companies will carry complete stocks of tube-turns in 45, 90 and 180-degree types. Tube-turns are seamless drawn, short radius fittings for pipe welding.

It also was announced that W. P. Curley and A. L. Breyvogel will continue as managers of the New York and Chicago branch offices, respectively.

Booklet on New Type Stoker

A 47-page illustrated booklet describing fully the superstation type stoker, its construction and operation, is called catalog MR-2 and distributed by Combustion Engineering Corp., of New York.

ANOTHER new tool of interest is the new Model 5 Bit by W.-K.-W. Co. of Hollydale, Cal., a multiple tooth bit — somewhat different in construction — but incorporating the same working principles as other W.-K.-W. bits and designed only for holes up to ten inches in diameter, is illustrated.



New Leeds-Northrup Meter

An illustrated pamphlet describing the principle and application of the L. & N. electrical CO_2 meter has been mailed out by the Leeds-Northrup Co. of Philadelphia.

BRAUN cooling sections are in widespread use as high pressure gas coolers, oil coolers, gasoline condensers and in other services. They embody the fine workmanship, rugged design and thorough engineering characteristic of all BRAUN apparatus. Even a cursory examination of their construction will disclose many distinctive features. The cover plates at both ends are completely removable to expose the tubes and headers for thorough internal cleaning . . . straight tubes arranged to prevent water bypassing . . . a variety of nozzle and pass arrangements . . . corrosion-resisting materials . . . all these contribute to their economy in operation and maintenance.

C·F·BRAUN & CO., LTD.

ALHAMBRA CALIFORNIA

NEW YORK 120 Broadway
HOUSTON Neils Esperson Bldg.
SAN FRANCISCO Russ Building
TULSA Kennedy Bldg.

When writing C. F. BRAUN & Co. *please mention The Petroleum Engineer*

New Blow-out Preventer Gives Remote Control of High Pressure Wells

BY the use of a 4-way operating valve located at a safe and easily accessible distance from the well, high and most dangerous pressures may be curbed without any member of the crew going near the derrick, according to Cameron Iron Works, Houston, Texas. This is accomplished by extending pressure lines from the source to the blow-out preventer which is mounted below the derrick floor. This valve opens and closes the preventer; a quarter turn in either direction is all that is necessary to perform each operation. This novel piece of equipment is made by the Cameron Iron Works.

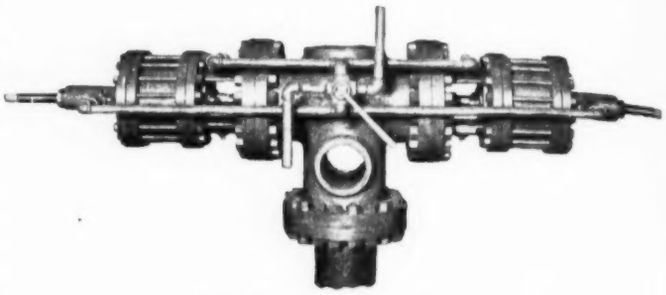
Manually-Operated Blow-out Preventer

These preventers utilize the tremendous amount of friction developed between steel and steel to hold the drill stem or casing in the hole. Two steel rams with concave faces grip the drill stem with a vice-like action. These rams are packed with a hydraulic rubber packing designed so as to become tighter when the pressure increases. In addition to the instantaneous closing by steam or other pressures the rams are securely fastened around the drill stem by 4-foot closing wheels which are extended away from the hole by 14-foot extension pocket wrenches.

These preventers are attached to the last string of casing by means of a flange which is obtainable in reducing sizes. Preventers are made in sizes from 6⅝ inches to 16 inches, depending upon the outside diameter of casing.

The manually operated blow-out preventer is identical in working principle and design. Instead of being closed by steam the steel rams are locked around the drill stem by means of huge closing wheels which are extended away from the derrick floor. These wheels are connected to the ram screws by means of universal joints.

A recent improvement on both these preventers is the addition of alemite lubrication of the rams. Alemite plugs

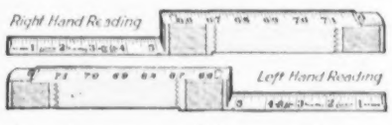

Steam-Operated Blow-out Preventer

are mounted on each side of top of the preventer with an opening clear through to the ram. They are guarded by a plug which also serves to prevent the escapeage of pressure.

Lufkin Rule Has New Features

A SPRING joint folding wood rule with several new and valuable features has just been put on the market by The Lufkin Rule Company, factory and main office, Saginaw, Mich.; Eastern sales branch, 106 Lafayette St., New York City. It is known as the "Two Way-Red End" Rule and lays claim to a number of decided advantages for carpenters and other mechanics, as well as all those who do common measuring.

On one side of the "Two Way" Rule figures run from left to right, i. e., right hand; on the other side they run from right to left, known as left hand. These two features have



never before been incorporated in one rule, say the makers. Right hand is the natural direction for much common measuring; left hand is most convenient when rule is held in left hand with pencil or saw in the right. With the "Two Way" Rule the figures are right-side-up to the user in many measuring operations where heretofore figures appeared upside-down. Thus convenience is served and chances of error eliminated.

The rule is made in white enamel finish, ⅝-inch wide with 6-inch sections, and in 4, 5 and 6-foot lengths. The "Two Way" is an addition to the Lufkin "Red End" Rules.

Latest Issue of "The Piper"

THE March issue of "The Piper," distributed by Jos. Greenspon's Sons Iron & Steel Co., contains many pictures and items of interest to all those who have any use for pipe in the petroleum industry.

For the Foxboro Loose-Leaf Catalog

THE following material for inclusion in the Foxboro Co., Inc., loose-leaf catalog has been received: Sheet No. GC-270A1, describing Foxboro Flow Recorder-Controller for liquids. Sheet No. GC-230A1, on Foxboro Single-Action Pressure Recorder-Controller. Sheet No. GC-300A2, on Foxboro Water-Proof Recorder Cases. Sheet No. GC-234A1, on Foxboro Pressure Non-Recording Controller. Sheet No. GC-344G1, on Foxboro Controlled Valves. Sheet No. GC-344J1, on Foxboro Controlled Valves, type 5100. Sheet No. GC-272A1, on Foxboro Volume Recorder-Controller, for gas and air. Bulletin No. 165 has also been received. It pertains to Foxboro gas meters for industrial and similar loads.

Chicago Pneumatic Opens New Branches

CHICAGO PNEUMATIC TOOL COMPANY, 6 East 44th Street, New York City, announces the opening of new branch offices as follows: Oklahoma City, Okla., Perrine Building; Tulsa, Okla., 327 Philcade Building; Houston, Texas, Merchants & Manufacturers Bldg.

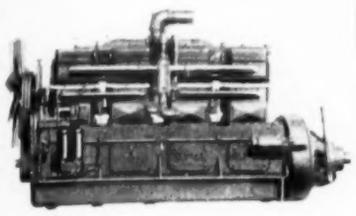
Service stations and warehouses have been established at both Oklahoma City and Houston, where air and gas compressors, engines, pneumatic and electric tools, rock drills, etc., will be carried, as well as parts for servicing. The establishing of these company offices, service stations and warehouses is said to be due to the increased business for the company's products in the territory served and is in keeping with the policy of the company to give prompt delivery and service in all parts of the world.

Furnace for Revivifying Filter Clays

The Nichols Copper Co. of New York has distributed Bulletin No. 200, describing Nichols Herreshoff Furnace for revivifying filter clays and fine filtering media.

Climax Announces Another Blue Streak Motor

CARRYING forward the policy of enlarging upon its field of activities, the Climax Engineering Company has just announced the completion of its straight 8-6″x7″, valve-in-head motor. All of the outstanding characteristics of the Blue Streak Series are incorporated in this new model. Valving, spark plug location, and flame travel are controlled to secure low detonating values and unusually smooth operation with high power output, the manufacturer states.



Other claims for the engine as made by the manufacturer are: It develops more than 200 h. p. at 1,000 r. p. m. and 225 h. p. at 1,200 r. p. m. The torque curve peaks at 600 r. p. m., giving approximately 1,145 pounds feet. Flexibility and lugging ability are remarkably apparent, the motor showing unusual "sweetness" and well-developed "hanging on" characteristics. It will deliver 100 pounds b. m. e. p. at normal recommended speeds, and the fuel rate is under 0.6 pounds per b. h. p. hour on gasoline.

This new model, known as the R81, is a triple fuel burning engine, operating on distillate, natural gas and gasoline.

Force feed lubrication is employed, three oil pumps being provided to handle the lubricating oil from the end and main fuel supply pumps. A duplex oil filter is used, all oil being carefully filtered before going to the bearings. A special oil strainer is provided to clean the oil entering the overhead valve system.

Ample cooling is taken care of by an extra large centrifugal water pump. The water enters at the top of the cylinders, giving thermo syphon action in the jackets, passing up through the distributing parts in the head, around the spark plug, between the valve pockets and combustion chamber, to the water outlet manifold. An eight-blade 36-inch fan with triple V-belt drive is incorporated in the design, with special mountings, for tachometer, fuel pump, and other forms of accessory drive.

The motor is equipped with two 2-inch Zenith carburetors, governor, magneto, and dual ignition. Two Leece Neville starting motors, one on each side of the engine, are used for starting purposes.

Pittsburgh Steel Products Moves Office

THE St. Louis, Mo., offices of the Pittsburgh Steel Products Co., of Pittsburgh, Pa., will be located at 1211 Ambassador Bldg., in the future, according to a recent announcement by Morvin Thomas, district manager of sales.

New Trackson Crawler Wheels

SIMPLICITY, durability and easy, smooth-running operation are qualities claimed for the new Trackson Crawler Wheels which are the most recent product of the Trackson Co., Milwaukee, Wis. These wheels are designed for installation on wagons, trailers and bummers to meet the heavy hauling requirements of the oil industry. Pipe line operators, lease owners, producing companies, contractors and many others will find them very useful equipment, the manufacturers believe.

New Literature on Petro Valves

PETROLEUM EQUIPMENT CO., Fort Worth, Texas, through Jon R. Long, is distributing literature relative to the Petro oversize standing valves and Nu-Alloy balls and seats. The oversize standing valves are machined from solid cold drawn steel bar and it is claimed by the manufacturers that Petro valves will not unscrew in operation, leak, nor will the crown become loose and work off. The literature describes the manufacture and relates the features of the Nu-Alloy balls and seats.

New Literature on Flolight Turbines

THE Hutchison Engineering Works, Chicago, Ill., is sending out descriptive literature showing the merits of Flolight Steam Turbines to be used in oil field illumination.

According to the manufacturer, all parts of the turbine are readily accessible and since no delicate adjustments are required, it is unnecessary to have expert attendants. The complete set is shipped carefully assembled and tested, and the only thing required to put it in operation is a few simple connections.

New Offices for Byron Jackson in Oklahoma City

EFFECTIVE April 1, 1930, Byron Jackson Co. established headquarters in Oklahoma City in the Smiser Building, at the corner of Shields and G Streets, conveniently located on "Supply Row." This new location will be official headquarters for Bud Vincent, Bob Cook, Troy McMillan, Monk Cook, Van Nelson, Al Ausmus, and for A. E. Raine, when he is in the Oklahoma City territory.

Representative stocks will be maintained under the supervision of D. O. Pugh.

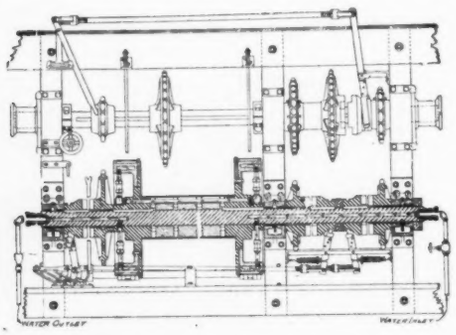
All oil men will find a hearty welcome awaiting them at the new address, states Byron Jackson Co. Inquiries for information should also be addressed there on and after April 1, 1930.

Cole Rig Power Unit

THE Producing Equipment Co. (James R. Cole), Tulsa, Okla., recently started marketing a "mule" operating a walking beam of a pumping well through a rod line and which lends itself to pumping heavy wells and wells where an extra long stroke is desired. According to the literature being distributed "Coles Standard Rig Power Unit" provides a simple, quick and convenient means of converting a standard rig into a balanced power where each well is picked up in sequence on its proportional part of the band wheel revolution. The apparatus is designed to prevent it from being pulled out of alignment when overloaded. Another claim is the down-pull holds the shaft in place and the rig is gripped together so that the racking strain of the side-pull rod lines does not materially affect it.

Dreadnaught Water-Cooled Draw-works

THE unusual conditions brought about by deep drilling called for improvements in the draw-works used for handling long drill stems. Difficulty was encountered in holding the load on the brakes, due to the excessive heating condition of the brake flanges from the friction of the brake bands. This heated quickly the binder in the asbestos lining, and frequently caused cracking in the brake flanges on the drum.

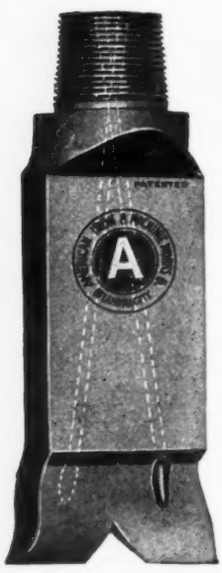


To overcome this condition, a water circulating system was designed by L. J. Black, and patents have been allowed. The system provides that the water enters through a swivel connection at one end of the drum shaft, through a hole bored in the center of the shaft. The brake flanges are provided with a channel or reservoir, running around inside of the rim of the brake flange. The water is taken from a side outlet in the shaft, makes a circuit of the hollow brake flange, passing through the drum center, making a circuit of the second brake flange, re-entering the shaft, and passing out at the opposite end through a second swivel connection.

The advantages claimed for this circulating system are that the brake bands and brake flanges being always cool, it is easier to hold the load on the brakes, reducing the effort needed on the brake lever, and because of the flanges being always cool, and the less friction necessary to hold the load, the wear on the asbestos lining is reduced to the minimum. The fire hazard from overheated bands setting gas on fire is removed.

The system is simple and water-tight, producing a dry rig, and the circulating water can be returned to the supply tank, and no waste of water is necessary.

Draw-works equipped with this cooling system have been in actual use for more than two years. They are manufactured and sold by the Beaumont Iron Works Company, Beaumont, Texas.



Gumbo Bit Folder

B. K. APPLEMAN, Beaumont, Texas, manufacturer of the Appleman Gumbo Bit, has mailed to the trade a folder entitled "More Hole at Less Cost," describing the features of the Gumbo Bit.

Naylor Pipe Moves New York Office

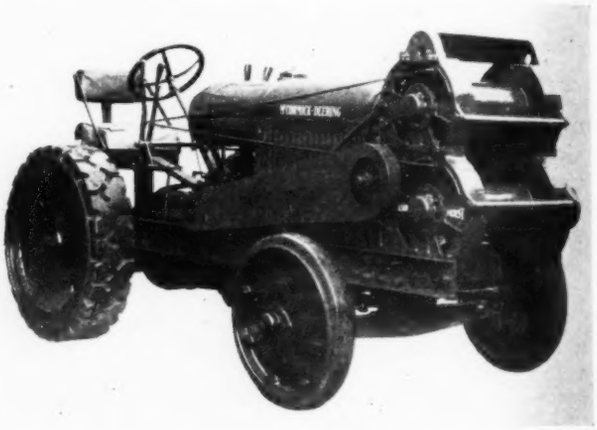
Naylor Pipe Company, Chicago, Ill., announces the removal of its New York office from 25 Church Street to new quarters at 3116 Chrysler Building, Lexington Avenue and Forty-second Street.

New Trackson Hoist Has Many Uses

PORTABILITY is one of the advantages of the new Trackson Hoist which was put on the market recently by the Trackson Company, Milwaukee, Wisconsin. This machine is built for mounting on the McCormick-Deering tractor, providing a flexible unit which can be driven from one job to another under its own power.

Among the variety of uses for this equipment are moving derricks and boilers, pulling rods, tubing and casing from oil and gas wells, erecting tanks, skidding heavy machinery, loaded trailers, etc., pulling big trucks up steep inclines and through mudholes and soft ground, and many other oil and gas field operations that can be handled to best advantage by a hoisting unit.

The Trackson Hoist was designed by J. E. Dale, well-known authority on hoists, who has been associated with the Trackson Company for several years. It is built to give reliable, uninterrupted performance and to stand up under the hardest usage. Its simple, correct design and all-steel construction insure a long life of service and maximum hoisting efficiency, the manufacturers state. Installation may be made quickly and easily. There are no holes to bore and no construction changes to make—the hoist is merely mounted on the power unit by means of 6-inch steel

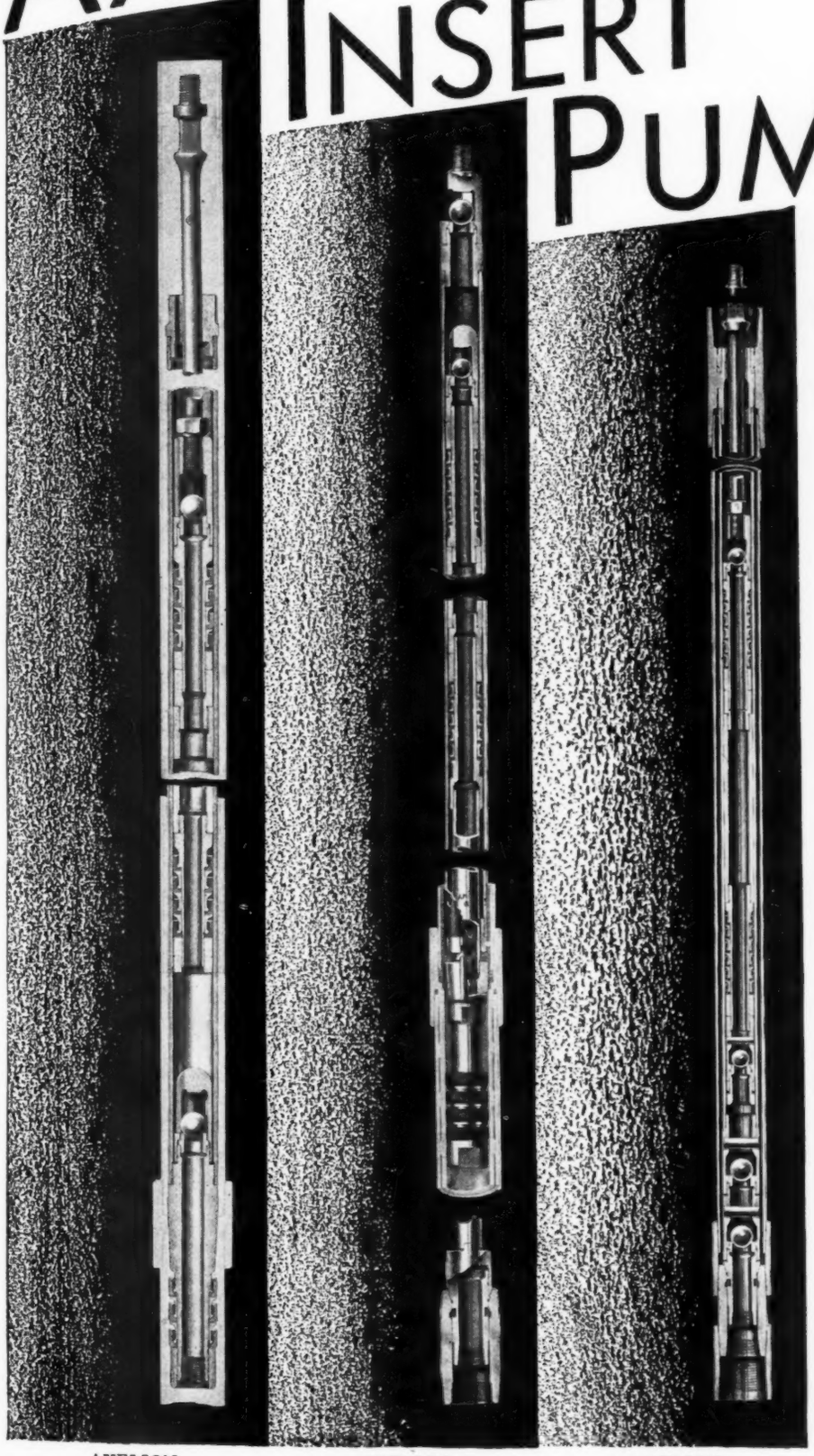


channels which extend from the front of the hoist and are attached to the tractor rear housing. The hoist may be mounted on either the wheel tractor or the Trackson Crawler-equipped McCormick-Deering; the crawler unit is recommended by Trackson Co., however, for work in difficult ground conditions, such as soft, loose sand or gravel, mud, marshy land or rough, hilly country.

Some of the new, exclusive features embodied in the Trackson Hoist are improved screw type clutches, oversized drum shafts and increased cable capacity, hand lever control and ready adaptability from the single to a double drum type hoist. The auxiliary drum may be attached as the user needs it, without any alteration to the main drum unit. It is mounted directly over the main drum, making a complete, compact two-drum machine.

The Trackson Hoist is built both in the portable model for tractor installation and as a stationary hoist. The latter has a material elevator spool which is adapted to endless cable work such as operating material elevator cages in construction jobs. The line speed is 290 feet per minute in both high and reverse gears, and 136 in low. The elevator spool is readily interchangeable with the gypsy spool and can be installed quickly. The stationary hoist has a dog type clutch, transferring the power from the main drum shaft to the elevator spool. The latter can be operated independently of the main drum. The brake is of extra large capacity, insuring long wear to the brake lining and ample ability to hold the load. It is operated by a left-hand lever and locking ratchet.

AXELSON INSERT PUMPS



AXELSON
REGULAR TYPE
INSERT PUMP
shown inserted in top collar of liner

AXELSON
TRAVELING TYPE
INSERT PUMP
with Ritter Standing valve attachment

AXELSON
ROD TYPE
INSERT PUMP
utilizing Ritter Standing valve

. . . for every Insert Pump need . . . . . .

To meet every pumping condition where an Insert Pump is desirable, Axelson manufactures three types of Inserts—namely:

1. **Axelson Traveling Tube Type Insert.**
2. **Axelson Rod Type Insert.**
3. **Axelson Regular Type Insert.**

Any one of the three pumps may be installed in the top collar of the old liner pump without pulling the tubing. Any of the types can be used with a Ritter Lock and Standing Valve if it is desired to pull the tubing.

The common practice, however, is to install the Traveling Tube type preferred in the larger producing wells with a Ritter attachment. The regular type insert pump is intended for use in smaller production wells nearly "pumped off".

The outstanding economy effected in using any of the insert pumps lies in the fact that the majority of pump fittings are interchangeable and can be used in both liner and insert pumps.

Complete information regarding these three dependable insert pumps is given in literature which will be gladly furnished upon request.

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

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Mid-Continent and Eastern Distributors
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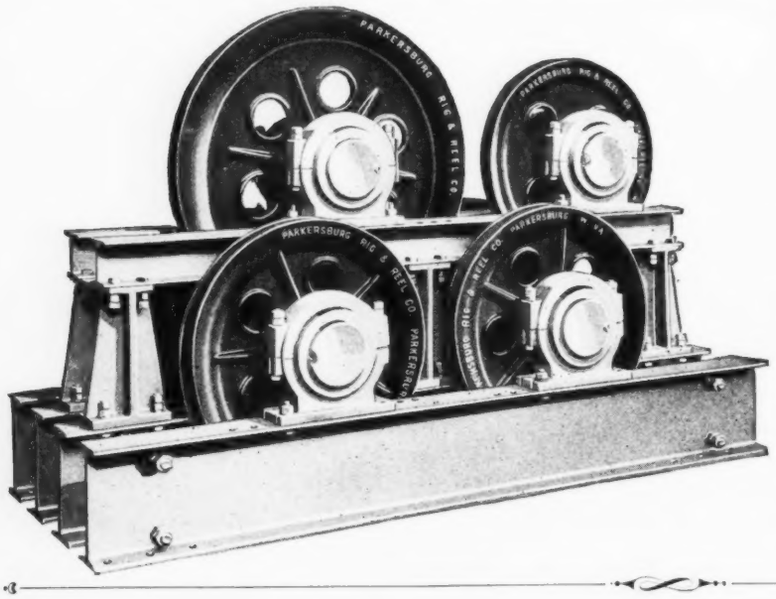
Parkersburg Double-Deck Roller Bearing Crown Block



TO MEET the needs of deeper drilling, an extra-heavy, drilling crown block was introduced by the Parkersburg Rig & Reel Co. It is roller-bearing-equipped and made in both single and double-deck models.

Roller bearings, with self-aligning boxes, manganese steel sheaves, A. P. I. rope grooves, alemite lubrication, and adjustable arrangement for rotary or combination derricks are chief features.

The double-deck design permits the use of large diameter sheaves and central perpendicular suspension of the lines to the traveling block.

The base frames of the new block are made of 12-inch, 40-pound I-beams, with special Parelite supports and spacer castings. It may be easily taken apart for hoisting, and is simple to assemble on the water table.

Six-sheave and seven-sheave blocks of this type are said to be in satisfactory use in some of the deep well districts of the Mid-Continent states.

New Factory Announced by B., S. & B.

ANNOUNCEMENT of plans for the erection of a new factory in Oklahoma City has been made by Black, Sivalls & Bryson, Inc., Bartlesville, Oklahoma—manufacturers of welded vessels and equipment, through its subsidiary, The American Tank Company of Oklahoma City. This factory will be erected on the site, containing about ten acres in the southwest part of Oklahoma City, at Westwood Boulevard and Poplar Street.

Black, Sivalls & Bryson, Inc., are well known throughout the oil fields, having been in business for more than two decades. This concern, and its affiliated companies, distribute their products through approximately fifty warehouses and branches strategetically located to serve the oil industry in the Mid-Continent field and Rocky Mountain area. In addition to its U. S. branches, it maintains a branch at Okotoks, Alberta, Canada, and has a sales representation at Maracaibo, Venezuela.

The new building, which has been designed by the engineering department of Black, Sivalls & Bryson, Inc., will be most modern and fully equipped.

The products to be manufactured at this plant will consist of many articles which are now manufactured at the old plant of the American Tank Company, including the American patented oil and gas separator, welded oil field tanks, welded bulk storage and filling station tanks, welded refinery equipment, welded piping, building caissons, bridge piers, packing house vats, condensor boxes, pressure drums, and other welded products manufactured according to specifications.

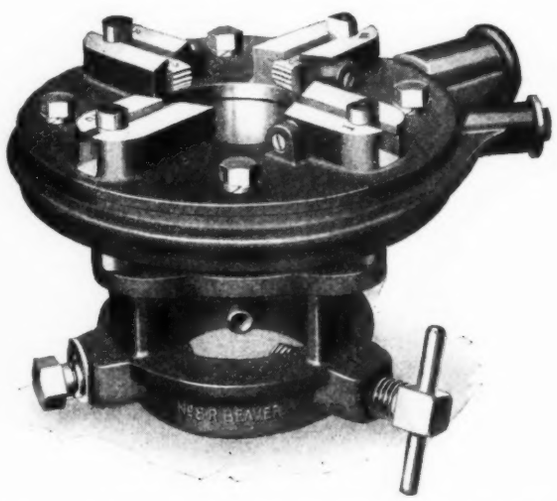
The increased capacity will afford the customers of these concerns the superior qualities and economies of modern welding, which will be possible through the installation of the latest equipment and properly planned shop practice.

The main building will be 140 feet wide and 260 feet long. It is a half monitor type construction and the height of the main section is 45 feet to the top of the roof. The side walls will be galvanized metal with very large window areas. The entire floor will be a six-inch concrete slab. Only three rows of columns will support the structure and crane-way. The entire area will be served by overhead traveling cranes, resulting in the greatest possible efficiencies in the manufacturing process. One of the cranes will be 60 feet wide and of 5-ton capacity. This crane will serve the machinery and preliminary phases in the process of manufacture. The other crane will be 80 feet wide of 10-ton capacity. This crane, which is of unusual width, will serve the assembly floor, and will have a lift of over 30 feet above the floor. The building will be served by switch tracks running inside and across the entire width which will result in economical loading and unloading of materials.

This building will be made of welded members. Not a rivet of any kind will be used in it. The idea is rather new, and this concern pioneers in the manufacture of an all-welded factory building of its size. The structure has been so designed that it will support the heavy loads of the five- and ten-ton cranes.

The Engineering Department of Black, Sivalls and Bryson, Inc., which is located at Kansas City, Mo., plans to have the plant completed and in operation by June 1st.

Beaver Four Poster Dies



THE Borden Company of Warren, Ohio, has mailed to the trade its Bulletin C-1, describing to pipe tool users the new Beaver "four poster" with a separate set of dies for each size of pipe. The "four poster" type of dies have, instead of bushings, a self-contained rear end convenient to use.

Not One Exposed Arc With EC&M Type ZO Switches

Type ZO Starting Switches and EC&M Vaporproof Push Buttons control these motors driving gasoline pumps.

Sound judgment tells the petroleum engineer to provide the utmost in protection against fire, because he knows this menace can not only destroy lives and property, but it can also eat up valuable portions of his revenue-producing product.

That is the reason why many petrolum engineers select EC&M Type ZO Across-the-line Starting Switches for starting and stopping their small A.C. motors. They know that there is not one exposed arc with Type ZO Starters—both main and overload contacts operate under oil and push buttons for remote or local control are of the vaporproof or oil-immersed type.

Bulletin 1048-P fully describes these starters and explains how they provide 100% safe operation in any explosive atmosphere. For larger motors requiring reduced voltage starting, Bulletins 1047-A and 1048 give complete information. Write for your copies.

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Good Products at Decreased Cost by USING PIPE STILL *for* » » RERUNNING

By
C. M. RIDGEWAY

THE pipe still is generally accepted as being the most efficient unit for conducting the primary distillation in a refinery. Consequently, it is surprising to note the rather general use of shell stills, operating batch or semi-continuous, for rerun purposes. This, to a certain extent, is due to the fact that many refiners do not feel that they can afford to junk their present equipment when as a matter of fact they cannot afford to operate this equipment if all of the savings that can be realized are taken into consideration.

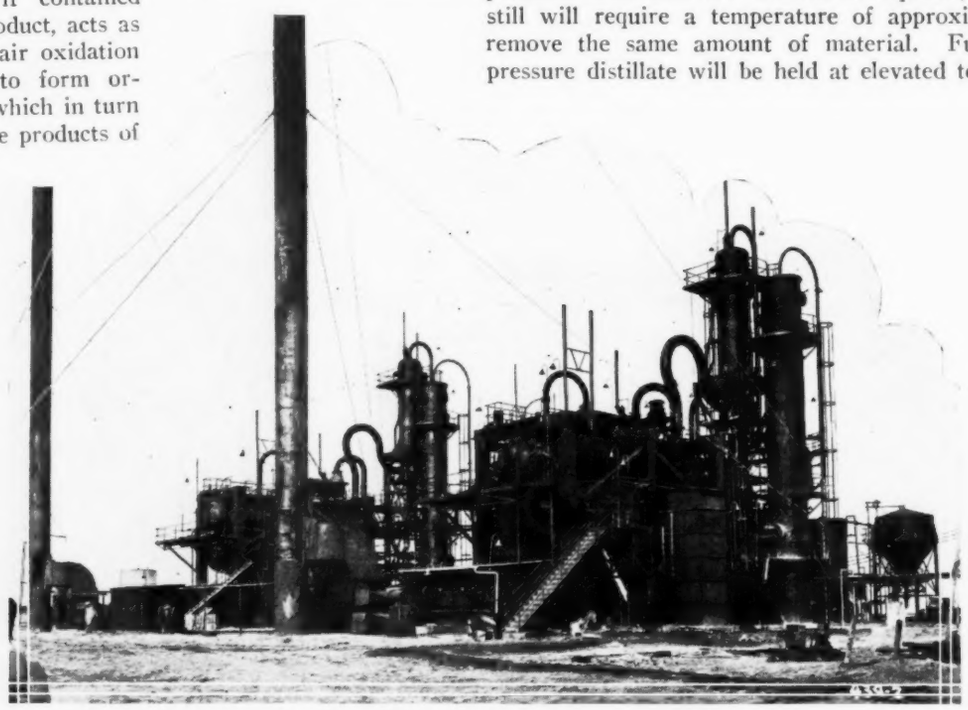
The hesitation in adopting the pipe still for distilling acid-treated pressure distillate may to a certain extent be due to the fact that some refiners have an entirely erroneous idea of the cost of such equipment. As a matter of fact, the cost per barrel is relatively low when compared to many of the more generally adopted pipe still installations. Furthermore, the savings realized by using this method of distillation would make the investment attractive if the installation cost was much higher than it actually is.

Acid-treated pressure distillate is rather unstable, more especially at elevated temperatures, due to its content of olefine substances and those compounds resulting from the action of sulphuric acid on the cracked distillate.

The use of a low distillation temperature is known to be desirable and is thought to be due to the fact that it minimizes the decomposition of the alkyl sulphates formed in the acid treatment and thus avoids the formation of sulphur dioxide, which, if contained in the finished product, acts as a catalyst in the air oxidation of the gasoline to form organic peroxides, which in turn decompose. These products of decomposition are themselves apparently catalysts of the further oxidation of the gasoline. The process of oxidation is thus an auto-catalytic one. It, therefore, is desirable, so far as possible, to avoid the presence of sulphur dioxide which serves as an initial catalyst in the oxidation. It should be noted that an alkali wash does not completely remove sulphur dioxide because of the hydrolysis of sodium sulphite and sodium bisulphite.

The use of low temperatures also minimizes the polymerization of the olefine substances, which polymerization results in a direct loss of material of gasoline boiling range. The decomposition of the alkyl sulphates and the polymerization of the olefine substances are chemical reactions which are tremendously accelerated by increasing temperatures. Consequently, every effort should be made to hold the operating temperatures within reasonable limits.

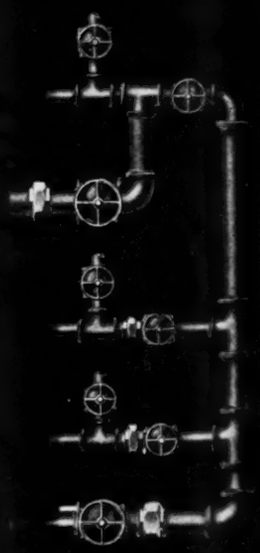
The distillation of acid-treated pressure distillate is a very critical operation and one for which the pipe still is pre-eminently fitted as it possesses inherent advantages over shell still practice both from the standpoint of economy and quality of product. The heated liquid is flash-vaporized rather than differentially vaporized, as when distilling from shell stills. As a consequence of this, a given percentage of the pressure distillate can be vaporized at a much lower temperature than is possible in shell still practice. For example: If a typical pressure distillate is cut without steam to 437° F. end point gasoline in a shell still a temperature of at least 450° F. will be required, whereas a pipe still will require a temperature of approximately 375° to remove the same amount of material. Furthermore, the pressure distillate will be held at elevated temperatures for



Pipe still in California refinery.

GAS

GAS



THE Regan-Trout-Rasmussen Gas Controller is used largely in connection with the "Miller Method of Drilling Through Gas Formations," although its application is suitable for other methods of cable tool drilling where a positive seal-off is essential. It permits uninterrupted operation against pressures, conserves gas and eliminates the hazard and danger from poisonous gas. This controller is the only effective means of drilling through prolific gas-bearing strata. The construction of the device consists primarily of a series of flanges which are attached to the last string of casing landed. The seal-off between strings is effected by applying the well pressure behind rubber sleeves which are confined within the flanges. The multiplicity of the flanges and rubber sleeves is for the purpose of by-passing couplings which is accomplished by applying the well pressure alternately between the top and middle rubber sleeves as the coupling is being passed through.

Ask for detailed information.

FULLY PATENTED

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Gas Controller

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SAN PEDRO (Los Angeles Harbor) CALIFORNIA, U. S. A.

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Wm. Braat, Manager

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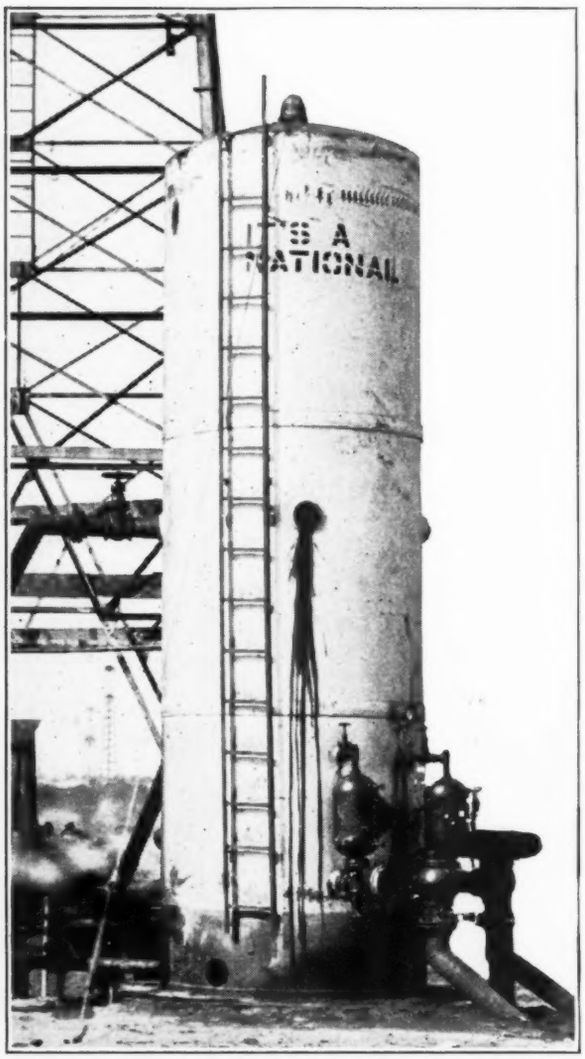
Can you equal this performance of NATIONAL SEPARATORS *with any other equipment?*



Farley-Fuzzell No. 1
Oklahoma City Field

Mid-Continent Distributors of

Lorraine Corp. Equipment
Lorraine Sucker Rod Racks
Lorraine Dual Controls for Oil and Gas Separators

An interesting test was recently made at the Farley-Fuzzell No. 1 Well, Oklahoma City Field, in an effort to determine performance efficiency.

One No. 1 A National Separator handled to clean separation the Farley-Fuzzell No. 1 Well, making:

102,364,000 cu. ft. gas per 24 hours; 31,250 bbls. oil per 24 hours; 95 pounds pressure on the separator; 510 pounds back-pressure on the well. Two 8¼ Gas outlet lines with one 8¼ National Back-Pressure Gas Valve in each line (wide open). One 6″ Oil Line to tanks and one combination 6″ and 5 3/16 Oil Line to tanks.

Part of this production was later turned into another separator. A charcoal test was made of the gas from the No. 1 A National Separator when volume was 76,372,000 cu. ft. gas with 80 lbs. on the separator, and 916 bbls. of Oil per hour was going through the Separator.

Gasoline content was .317 gallons per thousand cubic feet of gas at the riser.

Complete data, or further information, on this test will be furnished upon request.

Watch this magazine for data on other performances of National Separators in this the greatest of all Mid-Continent Fields

When writing NATIONAL TANK COMPANY *please mention The Petroleum Engineer*

hours in shell stills and the liquid next to the shell still will be at much higher temperatures than the average oil temperature, while in a properly designed pipe still the oil will only be subjected to relatively high temperatures for a few seconds and the oil next to the tube wall will be practically at the same temperature as the main stream of oil.

Some refiners, more particularly those processing cracked California or Gulf Coastal distillates, have resorted to the double flash method of pipe still distillation, in some cases using vacuum on the second stage. The single flash method will give satisfactory results where the average pressure distillate is being handled. One of the comparatively recent developments is the use of a stabilizer in conjunction with a pipe still rerun unit. This arrangement is rather desirable as it produces a stablized product at a relatively small increase in cost.

The general arrangement of the equipment and the method of operation of such a unit are shown on the flow sheet. The pressure distillate is pumped through the heat exchangers and the pipe still to the vaporizer where the gasoline and a small portion of the bottoms are vaporized. The vaporized portion of the charge passes upward and is fractionated in the rectifying section of the column. Gasoline of easily controlled end point is the overhead product. The temperature at the top of the column is maintained by using gasoline reflux. The larger portion of the bottoms is not vaporized, but, together with the liquid from the base of the rectifying column, flows to the steam stripping section below, where it is stripped in counter flow with steam. The same stripping steam will pass up the column and exert its partial pressure effect in the vaporizer, thus lowering the temperature required to vaporize the desired amount of distillate.

In shell still practice, the final still is kept around 400° F., requiring 100 to 120 pounds of steam per barrel. Whereas, in pipe still practice the vaporizer temperature need not be over 325° F. when using 30 pounds of steam per barrel. The fuel consumption of the shell still will be from 4 to 6 per cent and the pipe still will require approximately 1¼ per cent of the total volume handled.

Where pipe still distillation is practiced, the lightest components of the gasoline are condensed in contact with the higher boiling ones, resulting in a low distillation loss. A plant operating in this manner over a considerable period of time has had a distillation loss of 0.6 per cent. In contrast to this, distillation in a continuous shell still battery results in condensing the low boiling components out of contact with the higher boiling ones, with the result that the distillation loss is much higher, in some cases it amounts to 6 per cent.

The two methods of operation may be compared as follows:

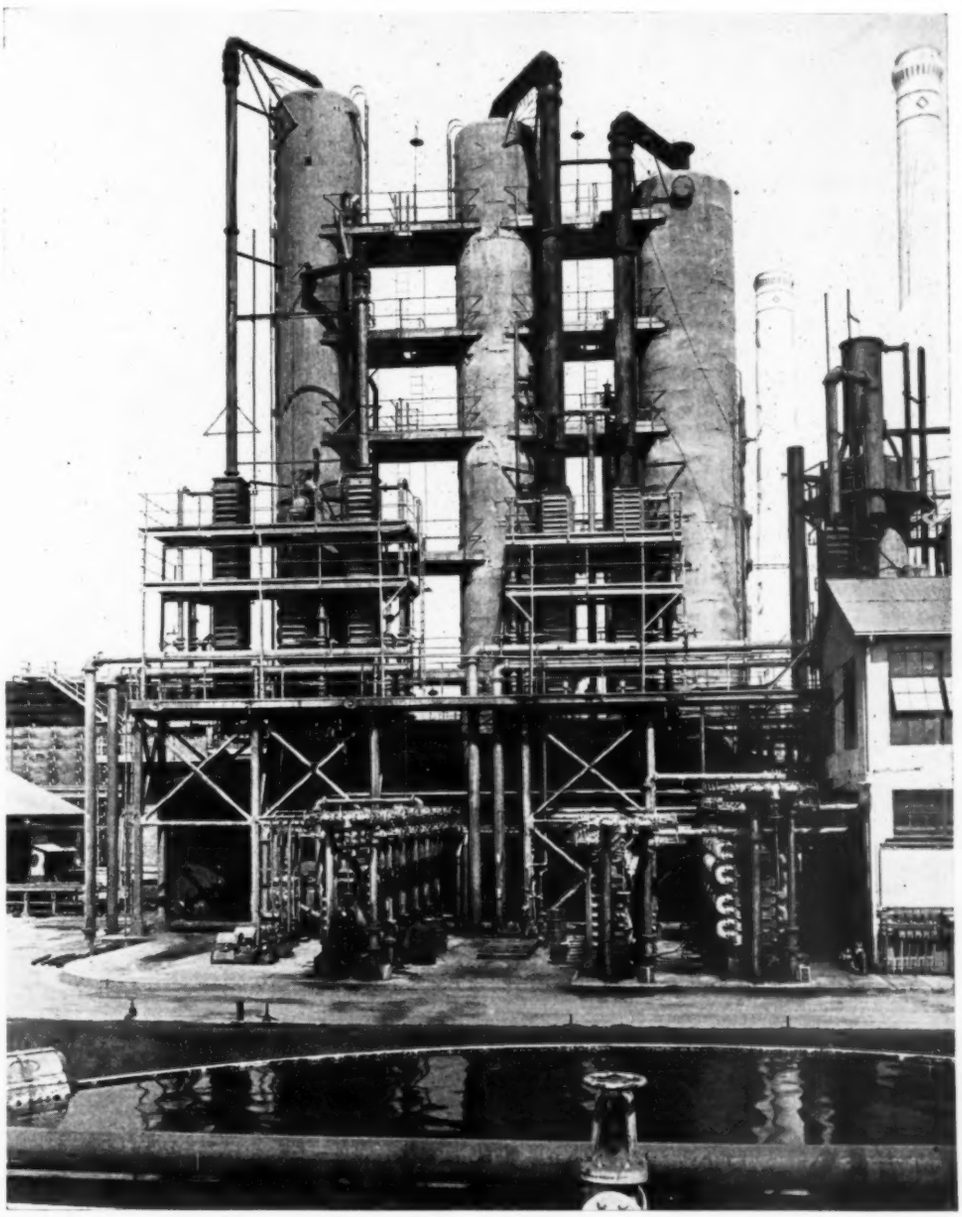
	Shell Still	*Pipe Still*
Steam	100-120 lbs./bbl.	30 lbs./bbl.
Fuel	4½-6%	1¼%
Loss	4-6%	Less than 1%

This indicates that the advantages of pipe still distillation of acid-treated pressure distillate may be summarized as follows:

1—Decreased steam and fuel consumption.

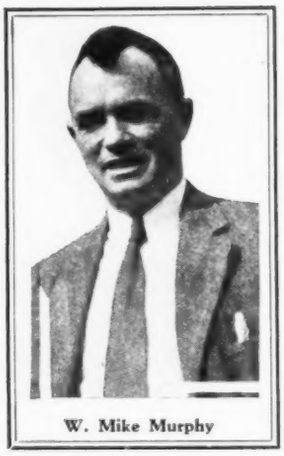
2—Decreased distillation loss.

3—Improved product.



Fractionating towers and heat exchangers.

RUNNING TOUR With Men In The Industry



W. Mike Murphy

W. Mike Murphy has resigned as superintendent of pipe lines for the Magnolia Gas Co., and has accepted a similar position with the Missouri Valley Gas Co., with headquarters at Omaha, Nebr. The newly organized company, a Moody-Seegraves interest, is in the preliminary stages of constructing a 24-inch welded gas line from southwestern Kansas to Omaha.

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Due to its increased foreign business, the Fluid Packed Pump Company has engaged the services of F. Harold Gray as special factory representative to look after their sales and service in European and Asiatic fields. For the past several years the company has had a factory representative in South American fields in the person of Tony Statts. Increased foreign business has necessitated adding another representative to its foreign sales department.

F. Harold Gray

Mr. Gray has had a varied experience in production work, having spent the last seven years in the service of the Standard Oil Company of New Jersey, in Mexico and Oklahoma. During the last year he has been associated with the Field Engineering Department of the Carter Oil Company in Seminole, Oklahoma, engaged in the investigation of pumping equipment.

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M. B. Crowe, formerly with Stockham Pipe & Fittings Co., has joined Key Boiler Equipment Co. of St. Louis, for which he will cover the Mid-Continent territory. His headquarters will be in Tulsa, Okla.

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J. A. (Jim) Morgan, for many years identified with the petroleum industry, has disposed of his interest in the Camp-Morgan Co. to C. F. Camp, who was associated with him. Mr. Morgan has announced that the next few weeks at least will be devoted to improving his golf game.

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Leonard E. Vaughn, who for more than a year has been sales manager for the Byron Jackson Co. in California, has been transferred to the New York office, located at 1245 Graybar Bldg., where he will have charge of export sales for the company. The increasing export business of the Byron Jackson Co. promises a successful future for Mr. Vaughn in his new location.

Robert M. Cook, formerly sales representative for BJ in the Mid-Continent territory, has been transferred to Los Angeles to assume the duties of acting sales manager of the California Division.

W. W. Grace, formerly production manager, has been appointed purchasing agent to fill the vacancy caused by the untimely death of George F. Clark.

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O. D. Strong has been appointed district sales manager for the Tulsa district, comprising the states of Oklahoma and Kansas, for the Reading Steel Casting Co., with headquarters at 214½ East Brady Street, Tulsa, Okla.

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W. T. Cushing, prominently identified with the pipe line industry for years, has resigned from the staff of the Dearborn Chemical Co. While no definite announcement has been made, he will probably head an engineering organization specializing in reconditioning pipe lines.

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Brian R. Muirhead, assistant treasurer, Arkansas Natural Gas Corp., Shreveport, La., was a recent Bartlesville and Tulsa, Okla., visitor.

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L. M. Batten, superintendent of production, Empire Gas & Fuel Co., in the Pampa, Texas, district, is recovering from an operation.

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Ian Duncan, formerly of Glasgow, Scotland, sailed recently for Santiago, Chili, where he will represent the Gardner-Denver Co., in the mining districts of that country. His headquarters will be with Spencer & Waters, Ltd., Chilean agents for Gardner-Denver. Duncan recently finished special courses offered in the Quincy plant of the company.

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F. C. Walters, former superintendent of gas measurement, Oklahoma Natural Gas Corp., has been promoted to superintendent of distribution plants, succeeding E. A. Clark, resigned. Walters, a graduate chemical engineer from the University of Kansas, has been with the company nine years.

F. C. Walters

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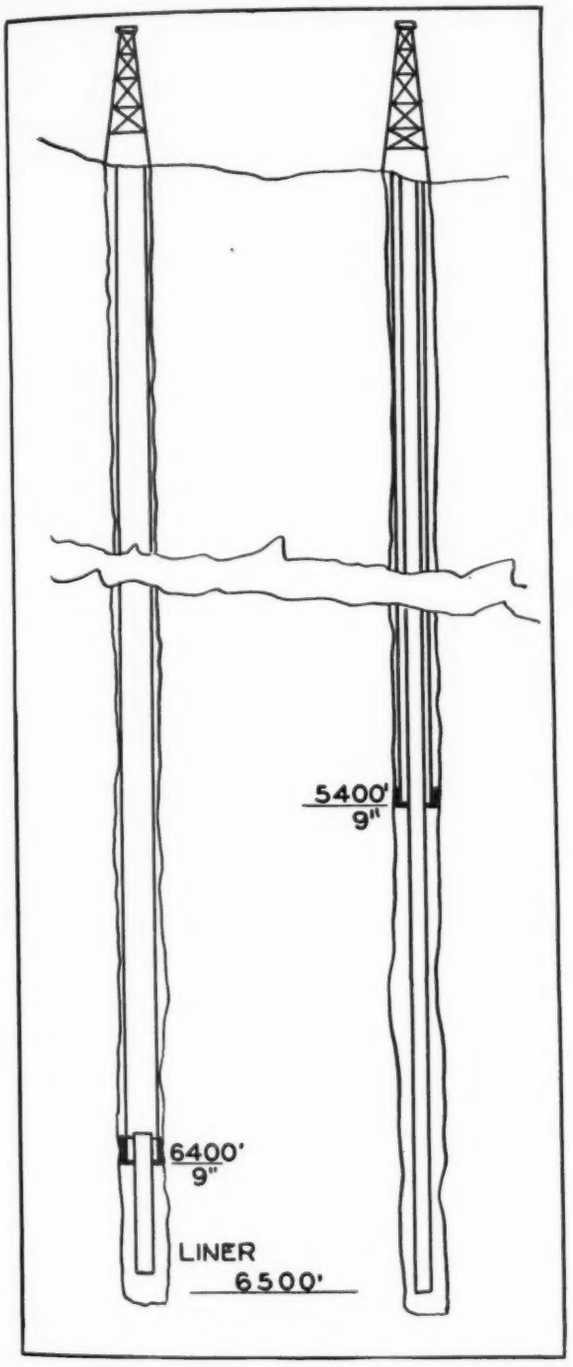
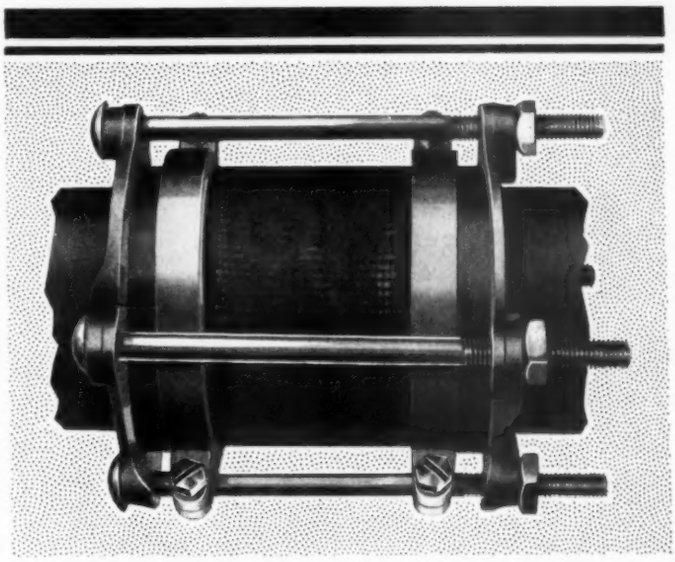
W. F. McCormick, sales representative of the C. F. Camp Co., Tulsa, Okla., has returned from California where he was called on account of the illness of his father.

Casing Practices *at* Oklahoma City

SOME of the companies operating in the Oklahoma City field are running one long string of nine-inch casing, landing it at 6,400 feet instead of at 5,400 feet as formerly practiced. By using the longer string of casing they finish up the well with a liner instead of with a full string of seven-inch casing.



The majority of the wells drilled in the field have set the nine-inch casing around 5,400 feet and used a full string of seven-inch casing to finish the well. This has been done with due regard to safety, the operators feeling that in a field where such heavy pressures were encountered the extra string of casing afforded exceptional protection. The accompanying illustration shows how each practice is worked out.



SKINNER
COLLAR LEAK
CLAMP for Repairing Leaky Collars

This clamp—operating on gland and stuffing box principle—shapes the rubbers to the job. Not dependent on collar recesses, as the gasket container rings guide the rubbers, always inward, into the leak. The Skinner Collar Leak Clamp is particularly valuable on rough or uneven collars. Made of malleable iron, for any pressure.

In stock at all supply stores.

M. B. SKINNER COMPANY
Sample St. at Falcon St. South Bend, Ind.

SKINNER

When writing M. B. Skinner Co. *please mention The Petroleum Engineer*

Temperature Regulators *and* Pressure Controlling Devices[1]

By

E. H. TRIPHAUS[2]

IN no division of what may be broadly termed the "Oil Industry" has expansion and refinement of equipment been more marked than in the manufacture of natural gas gasoline. From a humble beginning in the old compression plants of a comparatively few years ago, the natural gasoline industry has progressed to the point where approximately 14% of our total gasoline output is manufactured from natural gas. This contribution to the needs of civilization, as well as to the conservation of natural resources, has been in line with industrial progress, bringing about complete utilization of every fraction of crude oil.

In the perfection of the absorption plant, new designs of distillation equipment, and that greatest single item of improvement and development—the stabilizer—the industry has rapidly kept pace with the demand for its product. Improvement in practices and design of equipment are the fruits of scientific research for the control of a highly scientific process.

The manufacture of natural gasoline is fundamentally based on temperature and pressure conditions, and any improvements bringing about increased efficiency and greater economies are intimately linked with the degree to which these two factors are held under control. Progress in natural gasoline manufacture has entailed a corresponding improvement in the products of the instrument manufacturer to meet the new needs. The progressive has kept pace with the demands. In the realization that successful plant operation is dependent on the accuracy and the reliability of temperature and pressure instruments that will tell what the plant has done, what it is doing, and what it will do, the resourceful manufacturer has made available a line of dependable equipment complete for every gasoline plant requirement.

The use of industrial and recording thermometers and pressure gauges is an established fact in the natural gasoline industry, therefore, the writer will pass over this item realizing fully that you understand the importance of using properly selected and accurate types of indicating thermometers and gauges, as well as recording types. The indicating type is generally accepted more in the nature of a guide and most generally as the testing type, while the recording instrument's principal function is to have a continuous 24-hour or 7-day record of your temperatures and pressures, whether controlled automatically or manually.

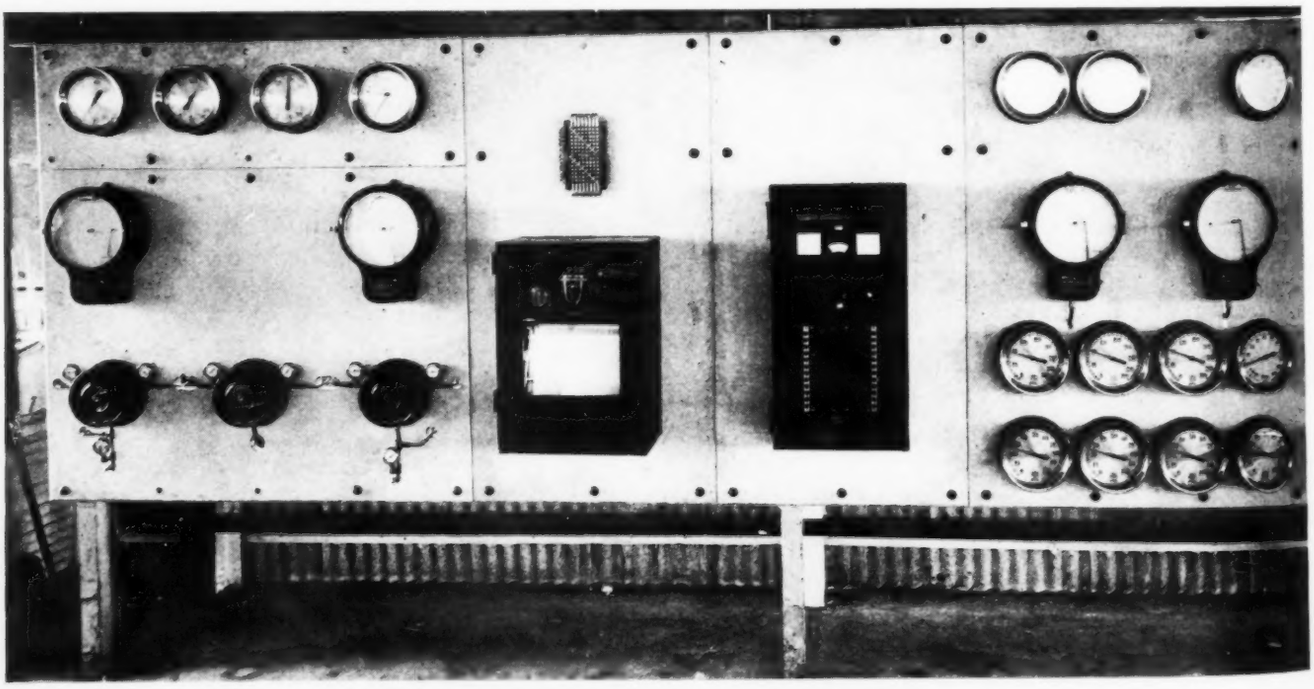
The growing use of automatic controls represents a tremendous step forward in the development and perfection of the ideally operated gasoline plant. While the indicating thermometer and pressure gauge will tell what the condition is, the recording thermometer and pressure gauge what the condition was and is, the efficient and dependable regulator will tell what the condition will be, once the instrument is set for the desired temperature or pressure factor.

The application of temperature regulators in absorption plants is evidenced principally in the control of temperatures of distillation and of fractionation. In the stripping still or evaporator, whether gas fired or steam heated, the temperature regulator is a safeguard against overheating with the attendant volatilization of the absorbent oil, overloading the knock-out box, and the production of high end point or off-color gasoline. As a preventative of unduly low still temperatures, it is an insurance against improper stripping of the oil, lowering the absorption capacity of the lean oil, and low producton.

The control of dephlegmator or knock-out tower temperatures determines the quality of the gasoline in respect to

1 Presented before the Annual Plant Operators Meeting of the Natural Gasoline Men's Association of America, Breckenridge, Texas, April 22, 1930.

2 District Manager, Taylor Instrument Companies, Tulsa, Oklahoma.



Automatic Control Instrument in a Natural Gasoline Plant.

color, end point and gravity. High dephlegmator temperatures result in particles of the absorption oil or the heavier ends being carried over into the final condensers and receiving tanks, thus contaminating the specification gasoline with high end point and off-color material. This necessitates re-running. Low dephlegmator temperatures raise the gravity of the product and likewise cut down production.

Efficient stabilization or fractionation is made possible by the application of temperature controls to the "kettle" and top of the fractionator column. Operating specifications are so close in this process that a variation in temperature of only a few degrees has a vital effect in the quality of the finished product. The stabilizer in great part owes its superiority over the old system of weathering formerly employed in the degree to which the factor of temperature can be held under control.

In low pressure or high pressure stabilizers, the temperature regulator is essential for maintaining a constant temperature in the "kettle," thus preventing overheating with a possible loss of valuable constituents through the gas discharge line, or insufficient heating resulting in improper stabilization. Upon the temperature regulator at the top of the fractionator column rests the final responsibility for the maximum recovery of a uniform stabilized gasoline.

The applications for pressure controllers in natural gasoline plants are extensive and diversified. Experience has proven the desirability for automatic back pressure control on accumulator tanks in compression systems as an aid in securing uniformity of production and smoothness of operation of the compressor plant. This application has proven one of the most important features of this phase of plant operation, not only in its benefit to the plant itself, but also in the gas lift system of oil production, where the gasoline compression plant furnishes the high pressure gas needed for the flowing of wells. Back pressure regulation on accumulators or at the compressor plant discharge maintains constant head pressures for gas lift operations, a factor on which successful application of this system of oil production is partly dependent.

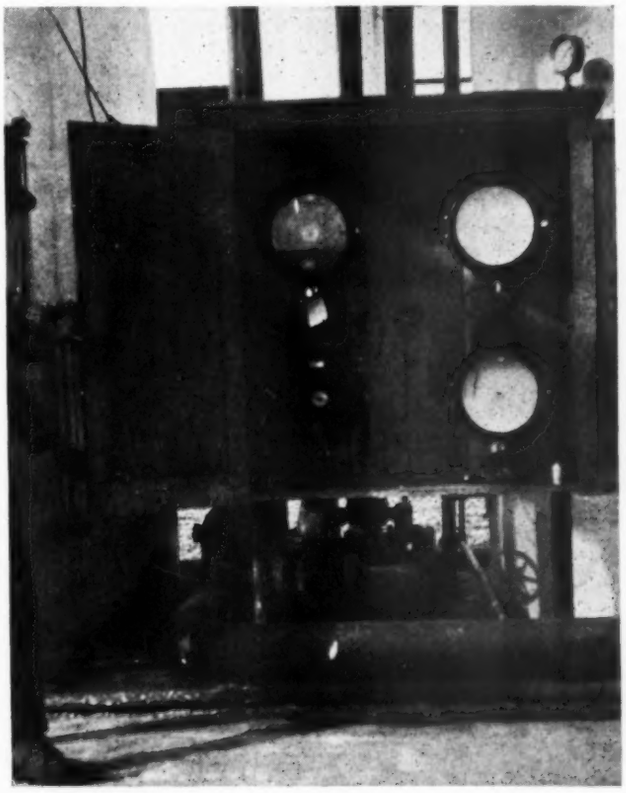
The desirability for automatic control of pressures in the suction line to compressors where the compression plant serves in the above capacity is brought out in conditions peculiar to the application. Since in the operation of the gas lift system the quantity of gas necessary to flow the wells varies from day to day, this means a variation in the quantity of gas available at the plant for compression. Under such conditions the gas frequently comes in heads, thus having a tendency to overload the plant engines and cause them to stop. Pressure control on the compressor suction side prevents overloading the engines and insures the uniformity of the entire operation.

Some systems maintain the desired suction pressure by means of an automatic valve which opens in case of excessive pressures. Others have in the suction line an automatic or diaphragm control valve which, working through a pressure regulator, closes with an increase beyond the desired pressure in the compressor discharge line and it is open at pressures below this point.

The back pressure controller on the absorber is an accepted unit in the absorption system of gasoline manufacture. Through the diaphragm operated valve in the outlet gas line it insures a constant pressure in the absorber which is an aid to the uniformity of wet gas and absorbent oil flow to the absorber and the efficiency of absorption.

Where the dry or lean gas from the absorbers is distributed for various uses, such as for the operation of plant engines, fuel for homes, fuel in the drilling of new wells, etc., reducing pressure regulators will automatically regulate the gas for the various usages. The back pressure regulator applied to the residue gas header from which the various supplies are taken will hold constant head pressures by releasing any gas in excess of the combined requirements.

In stills or knock-out towers operating under pressure, the back pressure regulator will prevent surging, overloading the knock-out tower, or the production of off-color gasoline, thus insuring uniformity of quality in the condensate and consistency in absorption plant processing.



Control Instruments in an Oklahoma City gasoline plant

The application of the back pressure regulator to high pressure gasoline fractionators is also a leading contributory factor to the remarkable success with which this comparatively new gasoline plant unit has met. When it is recognized that even under constant temperatures, pressure fluctuations can cause a condition of flooding in the fractionator, the loss of valuable constituents through the outlet gas line, or a condition of incomplete fractionation, the back pressure regulator becomes a vital factor in the production of uniform stabilized gasoline and the maintenance of standard plant output.

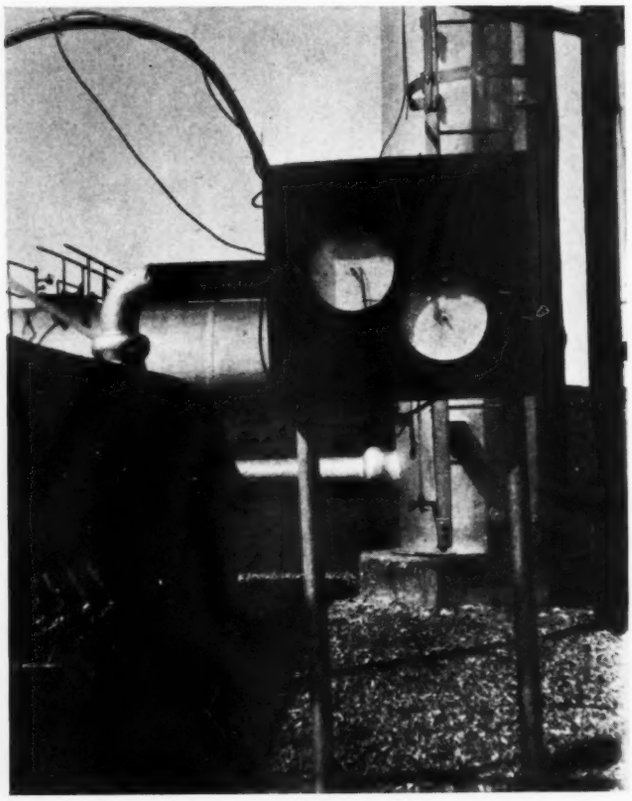
In the boiler house of the natural gasoline plant, pressure regulators will maintain constant steam header pressures through automatically firing the boilers. This type of installation is commonly spoken of as a gas fuel governor, though this terminology does not tell the complete story of what the installation really does. Its value is obvious in many plants from a study of operating sheets, or pressure charts, which show not a pound variation in steam header pressures over a 24-hour period. A single installation can be applied to a battery of boilers, and this closeness of control will be maintained when cutting in, or taking out a boiler at any point of the operation, without the operator at any time making any adjustments at the burner.

Back pressure regulators on storage tanks will maintain uniform conditions of storage, cut down evaporation losses, or the quantity of vapors sent to the recovery system.

Back pressure controllers on vent tanks will aid in a more uniform composition fat oil being sent to the stripper still, and a more uniform recovery for given conditions in the still.

Pressure controllers on pumps, either to maintain a uniform pressure of the steam supply to the pump or to maintain a uniform pump delivery pressure by varying the steam pressure and correspondingly the speed of the pump, are evident in all phases of gasoline plant operations dependent on pump actuation for the flow of fluids.

A modification of the pressure controller that has within the past few years come into vogue, and assumed a place of prominence in various phases of gasoline plant processing is the rate of flow controller or the rate volume regulator. This controller, designed to give a constant rate of charge to continuous operating units, is a co-operating factor with



Recording Instruments in the Oklahoma City field.

temperature and pressure controls in the assurance of an even balance of conditions throughout the various co-ordinating units that make up the plant.

In controlling the flow of absorption oil to the absorbers, "fat" oil to the stills, raw gasoline to fractionators or stabilizers, and as sometimes practiced, the amount of reflux to the fractionating tower, they aid in securing efficient extraction in absorbers, uniform quality of rich oil, efficient heat exchange, close control of the quality of vapors leaving the dephlegmator or knock-out tower, and uniformity in fractionation or stabilization.

The natural gasoline industry, however, has progressed considerably beyond the stage where the engineers and operators must be made to see the benefits of automatic regulation. Such advantages are now an accepted fact and it is up to the engineres to make, from a considerable number available, the proper selection of regulating equipment that will best meet the application in hand. This is not so easy as it may seem, in view of the fact that certain types of instruments are best adapted to certain types of applications.

Two general classes of regulators are the so-called self-acting and pilot operated types. The term "self-acting" is applied from the fact that no outside motive force is required for the instrument's operation.

The self-acting temperature regulator comprises essentially the tube system and valve. The tube system consists of the bulb member, connecting tubing, and the diaphragm element which controls the movement of the valve. The action of the valve is regulated directly by the change in vapor pressure of the volatile liquid in the tube system under the changing conditions of temperature at the bulb. From the nature of its operation this instrument is naturally limited in its field of action, particularly to those applications where extremely close control of temperatures is not essential. This does away with its possible use in gasoline plants on the various applications where automatic regulation and close control of temperatures are desired.

Self-acting pressure regulators are evidenced in the various reducing valves, where the operating pressure is the reduced line pressure itself taken from a point adjacent to the valve, or in the more improved instrument where the operating pressure is the reduced line pressure taken some distance away from the valve. In either case the changes in line pressure operate directly against a diaphragm in the valve to regulate the valve action. This necessarily cuts down the instrument's sensitivity and limits its application to processes where close control is not essential or where supply pressures do not vary greatly.

The pilot operated controller represents the most improved development in instrument manufacture, and is gradually coming to be standardized upon in the important phases of gasoline plant work. It provides that element of sensitivity which is conducive to close regulation on applications where a few degrees or a few pounds variation in temperature or pressures may result in considerable loss or disastrous condition upsets. The operation of the instrument requires an outside motive force which may be either compressed air at 15 pounds or 25 pounds pressure or the dry residue gas from the plant itself under the same pressures.

In the application of a pilot operated controller the temperature or pressure change in the apparatus does not work against the control valve directly, but against a small pilot valve in the instrument proper, which in turn controls the motive power for actuating the control valve. This step up action in a temperature or pressure regulator simply applies a principle early recognized and widely applied throughout all phases of industry. We see it illustrated in the running of our locomotives, in the workings of motors, in the operation of hoists, compressed air drills, or in the playing of the gigantic pipe organs, etc.

Pilot operated temperature controllers are furnished in two different types dependent on the convenience and conditions of application. These are the expansion stem, where the instrument face is immediately adjacent to the point of application, and the capillary type, where the instrument proper can be located up to 100 foot distance from the apparatus.

The expansion stem regulator consists of a sensitive member made up of two dissimilar metals of extremely different coefficients of expansions. The movement of the expanding member, under changing conditions of temperature, moves the non-expanding unit to open or close the pilot valve in the head of the instrument, thus regulating the air or gas supply for operating the control valve.

The capillary type instrument comprises the tube system and pilot valve. The tube system consists of the sensitive bulb member, the connecting tubing, and a flexible diaphragm or spring, all functioning as an integral unit. This system is hermetically sealed and may be solidly filled with mercury under pressure, partially filled with a volatile liquid, or gas filled. The volatilization, expansion, or contraction of the filling medium under the influence of heat causes a movement of the diaphragm or spring, which in turn operates the pilot valve controlling the motive supply for the diaphragm valve actuation.

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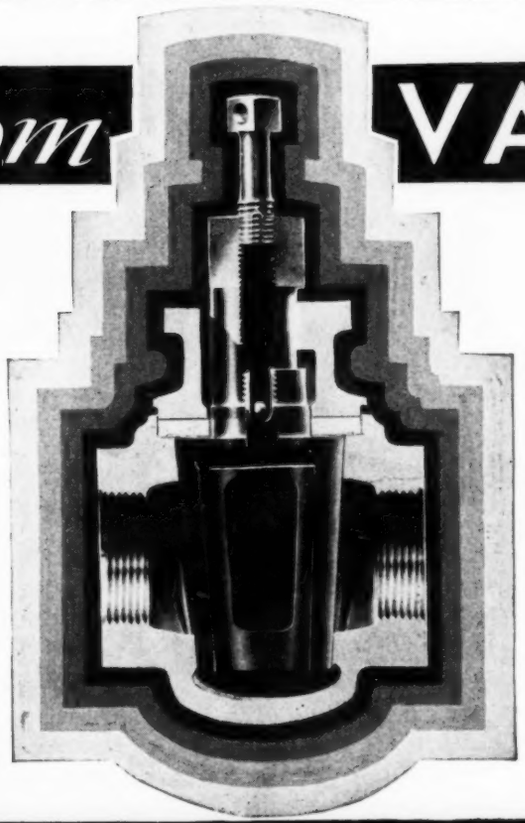

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The capillary type of regulator is furnished as a combined recording thermometer and temperature regulator, the flexible part of the tube system in this case being a spring which actuates the pilot valve, and at the same time traces a temperature record on the clock-driven chart.

It would doubtless be irrelevant to attempt a more minute description of the make-up of temperature controllers. Suffice to say, however, that the successful operation of this instrument is a concrete expression of the manufacturers' patience, skill and endurance in the proper selection of filling mediums, choosing of materials, co-relation of parts, and standardization of movements to give those qualities of uniformity, sensitivity and permanency to one of the most essential and exacting instruments of industry.

The proper instrument for the particular application is dependent on various factors, such as the actual temperature to be controlled, the desired range of the controller, the distance between the instrument location and the point of application of the bulb member, etc., or similar facts which influence the selection of the recorder.

In the pilot operated pressure regulator, the pressure under control operates directly against a diaphragm or a coil, which in turn operates the pilot valve controlling the motive power for the control valve actuation. The combined pressure recorder controller utilizes the spring principle.

The success of any control installation in a natural gasoline plant, whether temperature or pressure, is dependent to a great extent on the proper selection and construction of valves. Manufacturers of temperature and pressure controlling regulators must necessarily have as complete information as is possible to secure, but realizing that the variation in flows, capacities, etc., in your industry, we realize the desire to "play safe" and specify valve sizes amply large to take care of any contingencies. If you have a two-inch line, and are only using approximately one-fourth or one-half the capacity of that line, you will not secure the best control possible with an automatic regulator of either temperature or pressure. It is hoped that sometime in the future to be able to overcome this difficulty by making provision in the construction of diaphragm valves to compensate for these variations in the natural gas industry.

The pilot operated controller owes its popularity and success both to the elements of sensitivity and flexibility. It is used extensively as a remote controller, thus allowing panel board location of instruments or centralized control. It is flexible to the extent that its range can be changed by a replacement of the tube system in the temperature regulator or diaphragm element in the pressure controller. Its action from "direct" to "reverse," where the valve opens with the falling temperature or pressure, or "reverse" to "direct" under the opposite conditions, is accomplished by the exchange of pilots.

There is hardly a process in gasoline manufacture that operates on temperature or pressure and is adaptable to automatic regulation that cannot be controlled automatically from a selection of instruments from those described above. In each particular application, the application of indicators, recorders, and controllers, must be considered in order to properly select the instrument to give the best results. The construction of the apparatus to be controlled must also be considered so as to select the proper fittings and devices to make the installation more serviceable. For instance, there are special connections for jacketed or insulated apparatus, tanks, etc. It is only by investigating the construction principle of operation, the care in inspection, calibration and testing of the various instruments that confidence and satisfaction from their operation may be assured.

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AN IMPROVED METHOD *for* CRUDE ANALYSIS[1]

By G. A. BEISWENGER and WM. C. CHILD[2]

THE petroleum refiner is faced with the necessity of having some method of determining the quantity and quality of products obtainable from different samples of crude oils in order that he may observe changes in the quality of the crudes he receives, determine the advisability of buying crudes with which he is not familiar, and be able to determine the efficiency of his various pieces of equipment. The use of the 10 per cent distillation and the Hempel distillation are of some aid in this respect, particularly on the white products. When a more complete analysis is desired, a larger quantity of the crude is usually subjected to distillation with a degree of fractionation simliar to that obtained in the refinery, thereby separating it into the various cuts usually produced. These cuts are then inspected and, if desired, treated to produce the finished products.

The writers have had considerable experience with this method and have come to the following conclusions:

1. The above method is costly primarily because of lost effort and time in trial blending and also because of the necessity of actually producing finished products from the paraffin distillate before the quality of the lubricating oils obtainable can be predicted.

2. Yields are not exactly reproducible, due to variations in the degree of fractionation obtained.

3. Refinery yields are not duplicated, since the various distillation units, even in the same refinery, operate with different degrees of fractionation efficiency.

4. The cutting of a satisfactory paraffin distillate is difficult.

5. No information beyond yields, quality of products and the treating required is obtained.

With the above defects in mind, we have developed a new method of analysis which has been extensively used during the past year at our laboratory. Incoming shipments of crude have been currently analyzed and during the same period the method has been used in connection with test work on plant equipment and for investigating unfamiliar samples forwarded for analysis.

In this new method use is made of a true boiling point still—that is, a still fitted with a very efficient fractionating tower, thereby producing the various products with nearly perfect separation. The procedure has the following advantages:

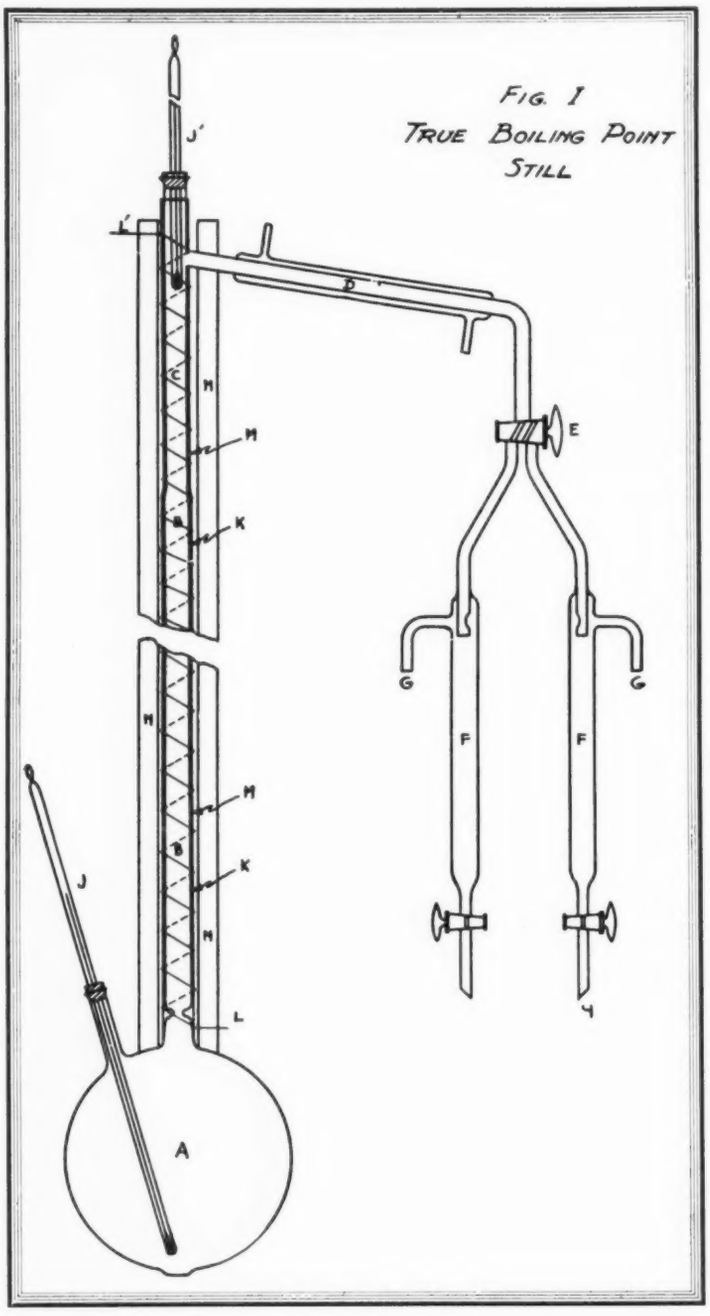


FIG. 1
TRUE BOILING POINT STILL

1. Results are accurately reproducible.

2. Since nearly perfect separation is obtained, maximum yields of more valuable products can be determined and thus a goal is set for the operation of refinery equipment.

3. Yields obtained in this analysis may be correlated with those obtained in individual pieces of refinery equipment. Thus the workup on a new sample of crude may be used to predict actual operating yields. The accuracy of this prediction is greater than if the analysis were made in equipment with a variable degree of separation.

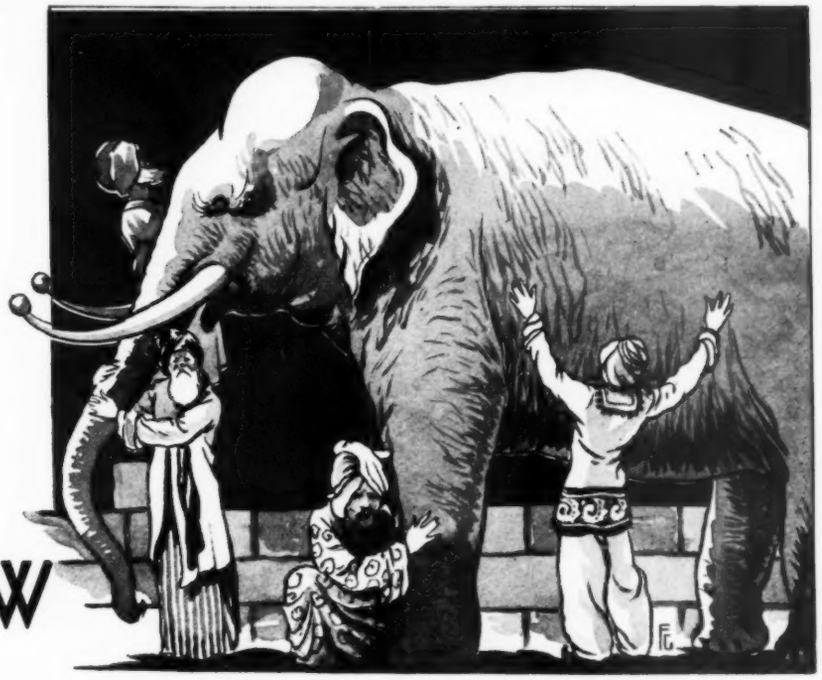
4. The workup is rapid. Only 16 hours are required for the operation of the still and blending of products. No treating need normally be resorted to.

5. The cost is much less than for the previous type of workup. One operator may run two pieces of equipment simultaneously. No time is lost in trial blending.

6. Many possible yield combinations can be quickly calculated from a given workup.

7. Due to data not obtainable in the previous type of workup, it is not necessary to produce finished products except as an added precaution in the

1 Presented before the Atlanta meeting of the American Chemical Society, April 7-11, 1930.
2 Technical Service Division, Standard Oil Co. of New Jersey.



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case of new crudes with which the refinery is not familiar.

8. Additional valuable data are obtained.

The disadvantage of this method is that, due to the small amount of material used (1600 c. c.), knock ratings of the gasoline and other inspections requiring large quantities cannot be obtained. An additional distillation is necessary in such cases.

It should be kept in mind that whenever distillation is carried out in the refinery under conditions resulting in cracking (decomposition), it is obvious that yields cannot be accurately predicted by any ordinary method of crude workup. In this new method of analysis yields and qualities of products are those obtainable in the absence of decomposition.

Description of Equipment

Any good true boiling point distillation equipment having a charging capacity of 1600 c. c. or more and designed to operate both at atmospheric pressure and under vacuum over the required temperature range may be used. The one described is simple, foolproof, easily constructed, not subject to leaks, and very efficient.

Figure I shows a diagrammatic sketch of the equipment. A indicates a 2-liter flask; B-C, a glass column 48 inches long from flask to vapor outlet, 1 inch O. D. at B and decreased to ¾ inch at C (upper 8 inches); D, condenser; E, three-way stopcock; F and F′, graduated overhead receivers; G and G′, vacuum connections; J and J′, still and vapor thermometers, respectively; K, asbestos paper wrapped around tower; L to L′, resistance wire for counteracting heat loss from tower; M, air space; and N, magnesia insulation.

The tower is packed with No. 16 brass jack chain for the lower third, No. 18 for the center third and No. 20 for the upper third. At three points along the tower (bottom, center and near top) the magnesia covering and asbestos paper are cut away and a glass window inserted, in order that the operation of the tower can be observed. When operating at the lower temperatures, reflux is produced by means of air jets introduced at the bottom and center of the tower. As the temperatures rise the air is gradually decreased and finally heat is applied by means of the resistance wire, L to L′, the amount being controlled by a lamp bank or rheostat. The amount of this cooling or heating is adjusted so that the tower is kept just below the flooding point at all times.

In order to decrease vaporization losses to a minimum the first cut is taken off through H into an iced receiver.

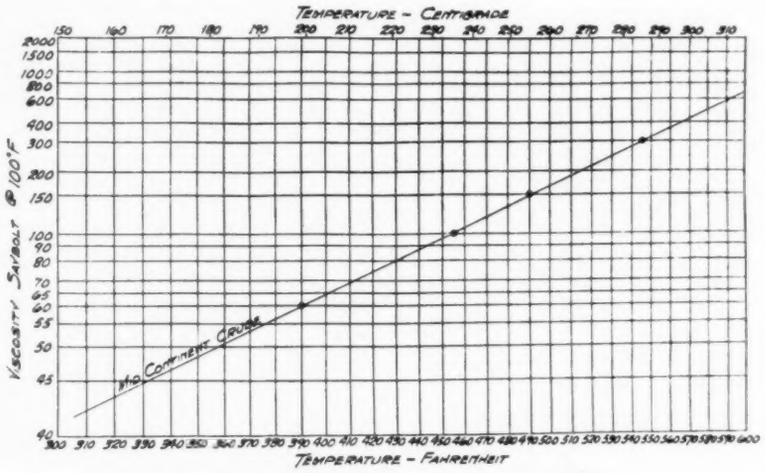

Figure II True Boiling Temperatures at 10mm. vs. Viscosity

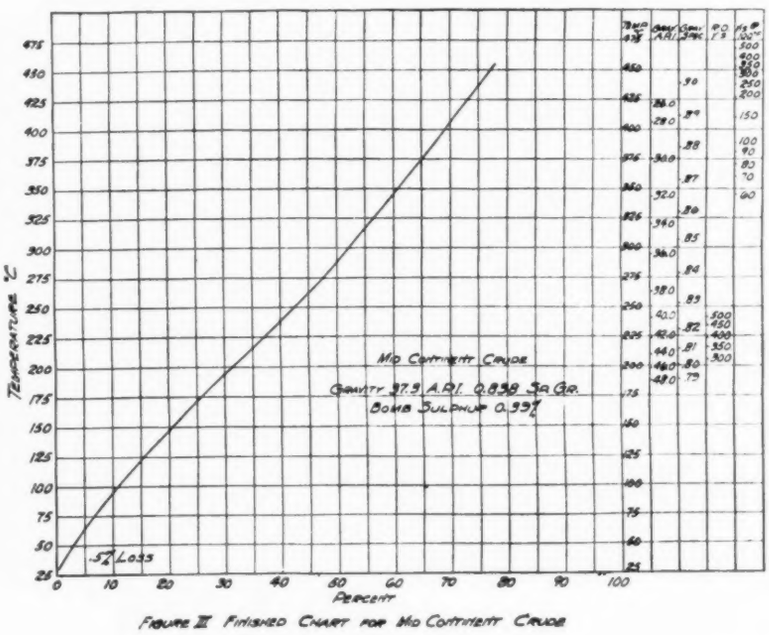

Figure III Finished Chart for Mid Continent Crude

Procedure

The procedure for making the workup is as follows:

1. Crude Inspection. A preliminary inspection of the crude is made. This may consist of gravity, sulphur, viscosity, flash, color, water, sediment and asphalt.

2. Operation of Equipment. The crude is charged to the still and run at 2 to 4 c. c. per minute, controlling the rate and amount of heating of the tower so that it does not quite flood. Cuts are made at 320° F. (160° C.) (stem correction of the thermometer should be made), 360° F. (182.2° C.), and 400° F. (204.4° C.). The equipment is then allowed to cool somewhat, the pressure is reduced to 10 mm. pressure and 3 per cent cuts on the crude are made from this point on. (A convenient schedule is to make a cleanout run in the equipment, charge, and remove the gasoline up to 400° F. (204.4° C.) on the first day. The following morning the pressure is reduced and the run finished.) To insure that no cracking takes place, the still temperature should not exceed 620° F. (327° C.). As the end of the run approaches, the pressure on the equipment should be decreased to 2 mm. or 3 mm. and the heat on the tower should be increased so as to decrease the reflux and hence the pressure drop through the tower. If this is done, practically all of the paraffin distillate will have been taken overhead.

Where extreme accuracy in yield determination is desired, the gas evolved during distillation can be measured. It is often desirable to pass this gas through wash bottles containing caustic soda to determine hydrogen sulphide.

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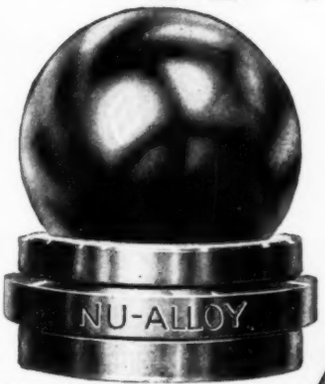

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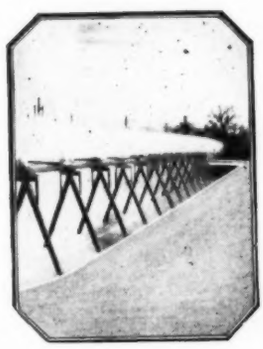

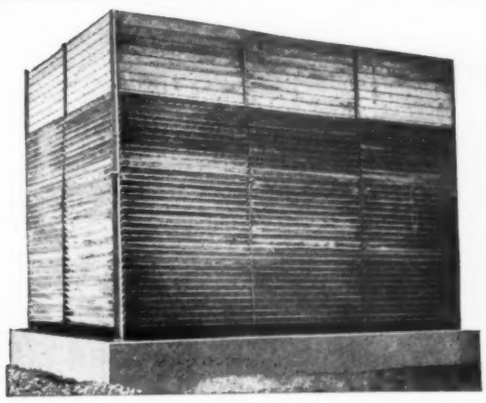

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3. Inspection of Cuts. Each one of the cuts above 320° F. (160° C.) vapor temperature is inspected for gravity. A refined oil viscosity is also obtained on each of the lighter fractions, while the heavier ones are blended into pairs and Saybolt viscosities at 100° F. (37.8° C.) are obtained.

4. Preparation of Gravity and Viscosity Data. From the data obtained in 3 above, gravity vs. per cent off is plotted, using the mid-point of each cut as its per cent off. For example, if the cut from 50 per cent to 53 per cent on the crude has a certain gravity, this gravity is shown at 51.5 per cent. The data from this gravity curve are transferred to a final chart later.

Similarly, refined oil viscosity is plotted against per cent off, again using the mid-point of each cut so that these data may also be easily put on the final chart later.

A plot is also made of the Saybolt viscosities. However, greater accuracy may be obtained at this point by using, instead of ordinary co-ordinate paper, the chart developed by the Texas Company and printed by the Emil Greiner Company for plotting change of viscosity with temperature. If the temperature axis is altered as in Figure II to show vapor temperatures at 10 mm. pressure, it will be found that a plot of viscosity at 100° F. (37.8° C.) vs. vapor temperature at 10 mm. is a straight line. Two or three points, therefore, fix the curve and any errors in viscosity determinations are easily detected. The temperatures selected are again those of the mid-points of the cuts inspected. These data will also be transferred to the final chart.

5. Construction of Final Chart. The true boiling point curve is constructed on co-ordinate paper so as to show the gas loss at the lower end. See Figure III. A convenient paper is the 10x15-inch ruled in half-inch squares, subdivided into tenths. The temperatures obtained at 10 mm. are converted to atmospheric, using vapor pressure-temperature data for hydrocarbons such as are given by Cox:

Ind. Eng. Chem. *15*, 592, 1923;

Calingaert and Davis:

Ind. Eng. Chem. *17*, 1287, 1925;

and O. G. Wilson, Jr.:

Ind. Eng. Chem. *20*, 1363, 1928.

For our use we have constructed a curve from averaged data showing the corrections to be added to the temperatures observed at 10 mm. to convert them to atmospheric conditions.

On the right-hand side of the curve four parallel columns are made. In the first the temperatures appearing on the vertical axis are repeated for ease in reading. The corresponding gravities are transferred from the preliminary curve described above to the second column. Similarly, the refined oil and Saybolt viscosities are transferred to the third and fourth columns, respectively.

6. Blending and Inspection of Final Products. The blends made depend upon the products the refiner normally produces. For our example we assume that we desire a gasoline with end point not exceeding 390° F. (198.9° C.) and a 400 viscosity refined oil of 110° F. (43.3° C.) minimum flash.

The cut taken up to 320° F. (160° C.) vapor temperature is inspected for gasoline obtainable when cutting maximum refined oil, and another blend up to 400° F. (204.4° C.) inspected for maximum 390 E. P. gasoline. Provided the yield of gasoline is not too small, distillation, gravity, color, sulphur, doctor, and corrosion may be obtained on each grade. If proper fractionation is used, the first sample will have an end point of about 320° F. (160° C.) and the second about 390° F. (199° C.).

Maximum refined oil is blended by using all cuts between 320° F. (160° C.) and the point shown on the chart as 400 refined oil viscosity and then adding an equal percentage above this point. Similarly, refined oil obtainable when cutting maximum gasoline is blended by using the cuts between 400° F. (204.4° C.) and 400 viscosity and then adding an equal number above this point. These blends are inspected for viscosity, gravity, sulphur, color, corrosion and doctor.

A gas oil cut starting at the end of the maximum refined oil and extending into the paraffin distillate is blended and inspected for gravity, aniline point and sulphur.

If an inspection on paraffin distillate other than gravity and viscosity is desired, all the cuts coming over after the maximum refined oil may be blended. This may be inspected for pour, per cent wax, and anything else desired.

The crude bottoms are inspected for gravity and viscosity. Sediment and hard asphalt may also be obtained if desired.

Summary of Workup

The finished report consists of the final chart described above and a summary. This summary, covering one typewritten page, is given in two parallel columns; one, yields obtained when cutting gasoline to 320° F. (160° C.) vapor temperature, and the other to 400° F. (204.4° C.). These are essentially workups for maximum 400 Visc. 110° F. (43.3° C.) Flash refined oil and maximum 390 E. P. gasoline, respectively.

(1) Workup for gasoline to 320° F. (160° C.).

(a) Loss. The difference between crude charged and recovered products is shown as loss.

(b) Gasoline yield is read from the chart as the amount up to 320° F. (160° C.), minus gas loss, and its inspection is that outlined in 6 above.

(c) The refined oil blend made up in 6 above will not usually show exactly 400 viscosity, because with no cuts smaller than 3 per cent it is impossible to obtain exactly the blend desired. Moreover, the gravity of a wide cut is usually a little lighter than that of its mid-point. To give strictly comparable values in the summary, refined oil yield is recorded as being twice the percentage indicated between 320° F. (160° C.) and 400 viscosity. Its viscosity is thus 400 and its gravity is that of the wider blend inspected in 6 after correcting for any deviations from 400 viscosity that the blend may have shown. That is, if the blend had a 390 viscosity and a 42.5° A. P. I. gravity, and the chart shows a 0.2° A. P. I. change in gravity for a 10-point change in viscosity, the gravity should be recorded as 42.3° A. P. I. The remainder of the inspection is recorded as being that of the blend.

(d) There is usually no gas oil in this workup.

(e) Paraffin distillate is considered to be that portion between the refined oil and the crude bottoms. Its viscosity and approximate gravity will be those of its midpoint. As suggested in 6, other inspections may be obtained if desired.

(f) The yield and inspection of crude bottoms are as stated in 6.

(2) Workup for gasoline to 400° F. (204.4° C.).

(a) Loss is as in (1) (a).

(b) Gasoline is as in (1) (b), except that 400° F. (204.4° C.) vapor temperature is used.

(c) Refined oil is as in (1) (c), except that 400° F. (204.4° C.) is the starting point.

(d) Gas oil is the stock between the refined oil and the paraffin distillate. Its gravity is read from the chart at its mid point.

(e) Paraffin distillate is twice the yield shown between

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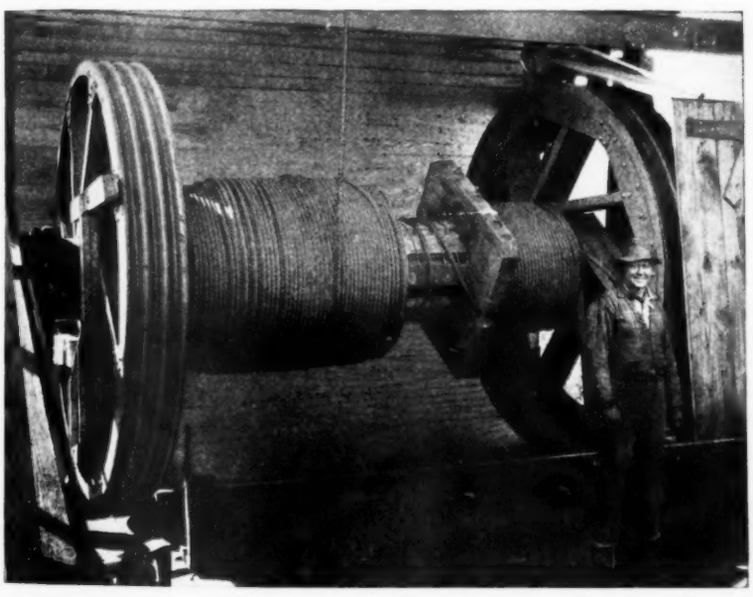

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NORRIS BROTHERS, *Inc.*

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70 Saybolt viscosity and the crude bottoms. Its viscosity is 70 and its approximate gravity is read at the 70 viscosity point.

(f) Crude bottoms are as in (1) (f).

The gas oil blended and inspected according to 6 above is shown as a separate item below the above summary because it overlaps the products outlined above.

Information Available from the Chart and Summary

The yield of any end point gasoline obtainable when using excellent fractionation may be read directly from the chart. After a little experience with various pieces of refinery distilling equipment, these yields may be easily converted to those obtained in the large unit. Other inspections on the gasoline cut in question may be determined with the aid of the two samples that were inspected.

The yield of any viscosity refined oil after any yield of gasoline may be determined from the chart by taking twice the percentage shown between the gasoline (plus loss) yield and the refined oil viscosity desired. This estimate holds very closely regardless of the type of equipment used in running the crude, provided the fractionation is essentially the same at both ends of the refined oil cut. The gravity will usually be a trifle lighter than that indicated at the desired viscosity, the wider the cut, the greater the deviation becomes. Other inspections may be estimated from the two samples inspected.

Gas oil is essentially that obtained in fractionating equipment giving a minimum of cracking, such as a pipe still. Gravity may be obtained for any cut. Sulfur and aniline point may be estimated. The latter is an indication of the ease with which the gas oil would crack and of the knock rating on the resulting gasoline.

Paraffin distillate and lubricating oil yields are again essentially those obtained in pipe still rather than shell still equipment. The quality of the lubricating oil obtainable can be closely estimated from the viscosity-temperature-gravity relationship shown in the work up chart, the temperature being indicative of the flash to be expected. The method, as outlined above, of estimating the viscosity of any part of a crude by reading the value at its mid point has proven exceedingly useful. The accuracy of this method is not impaired by the width of the cut in question nor the type of equipment on which it is to be made, provided only that the fractionation is the same at both ends of the cut and that no cracking is done. The gravity is also accurately estimated provided the cut is not too wide.

The maximum amount of pressable distillate obtainable from a mixed base crude when operating with good fractionation and no cracking can be closely approximated by considering the upper end of the cut to be limited to an average of the 870° F. (465.5° C.) and 600 viscosity points on the work-up. The yield is then obtained by doubling the difference between this point and that at the desired viscosity. For a paraffin base crude the cut temperature is usually somewhat higher.

The bottoms obtained are again essentially those obtained in equipment giving no cracking.

The molecular weight of any cut on the crude can be closely approximated by the following procedure: First, the temperature corresponding to the mid point of the cut is read off the final chart. Then the molecular weight of the paraffin hydrocarbon corresponding to this temperature is obtained and multiplied by 0.95 to give the molecular weight of the cut. It is obvious that if the cut is very wide, it should be split up into two or more equal portions, each one of these treated separately as above and the molecular weight of the whole calculated from the parts to insure accuracy. Normally this method gives results accurate to within 5 per cent.

Pipe Coating Manufacturers Form New Association

AT the American Petroleum Institute meeting in Chicago in December, 1929, manufacturers considered in an informal way the question of forming an association of manufacturers of materials for protecting underground pipes against corrosion. The informal meeting seemed to unanimously approve this idea with the result that negotiations were carried on between the leading companies in the industry. These negotiations culminated in a meeting of representatives of eleven of the leading companies in Tulsa on March 17th.

E. M. Converse

The result of this meeting was the organization of an association known as the "Underground Pipe Protection Institute." The objects of this organization, as expressed in the Constitution, are as follows:

To create a medium through which the members may establish authoritative relations with organizations studying the subject and the economics of the protection of underground pipe against corrosion, such as, the Bureau of Standards, American Petroleum Institute, American Gas Association, American Water Works Association, and similar technical organizations.

E. S. Browning

To promote a better understanding of the problems surrounding the subject and the economics of the protection of underground pipe against corrosion.

The advancement of the interests of its members and the establishment of friendly relations with the members of technical societies interested in the subject and the economics of the underground protection of pipe.

To establish and encourage ethical practices within the industry.

W. H. T. Thornhill

The officers of the Institute are as follows: President, E. M. Converse, Dearborn Chemical Company, Chicago; Vice President, E. S. Browning, Hill-Hubbell Division, General Paint Corporation, Chicago; Secretary-Treasurer, W. H. T. Thornhill, Wailes Dove-Hermiston Corporation, New York. These officers, with E. V. Rinehardt, Johns-Manville Corporation, New York, and William H. Kershaw, The Texas Company, New York, constitute the board of directors.

The companies represented at the organization meeting were the following: Hill, Hubbell & Company, Division, General Paint Corporation, E. I. Du Pont de Nemours & Co., Inc., McEverlast, Inc., The Barrett Co., Sherwin-Williams, Co., Johns-Manville Corp., Dearborn Chemical Co., The Arco Company, Wailes Dove-Hermiston Corp., The Phillip Carey Co., The Texas Company.

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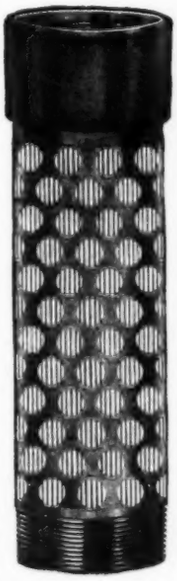

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Processes and Formulae Necessary in

Lime Soap Grease Manufacture

By S. J. CAPLAN, *Chemical Engineer*

Introduction

THE most widely used grease is undoubtedly, the ordinary boiled lime soap, properly emulsified with mineral oil and a small amount of water. This grease appears in an infinite variety of consistencies and colors.

In the lubrication of ball bearings and mine cars the consistency of the lime soap grease will vary from that of a product slightly heavier than a viscous oil, to a product exactly like ordinary vaseline, in appearance. For heavy duty work in a steel mill, a lime soap grease is used that is almost stiff enough to resist the pressure of the fingers. The ordinary ball bearing greases are perfectly transparent and usually have a light golden color, whereas a number of exceptionally useful lime soap greases are pitch black—in fact they may contain considerable quantities of pitch, in order to help them adhere to the moving surfaces that are to be lubricated.

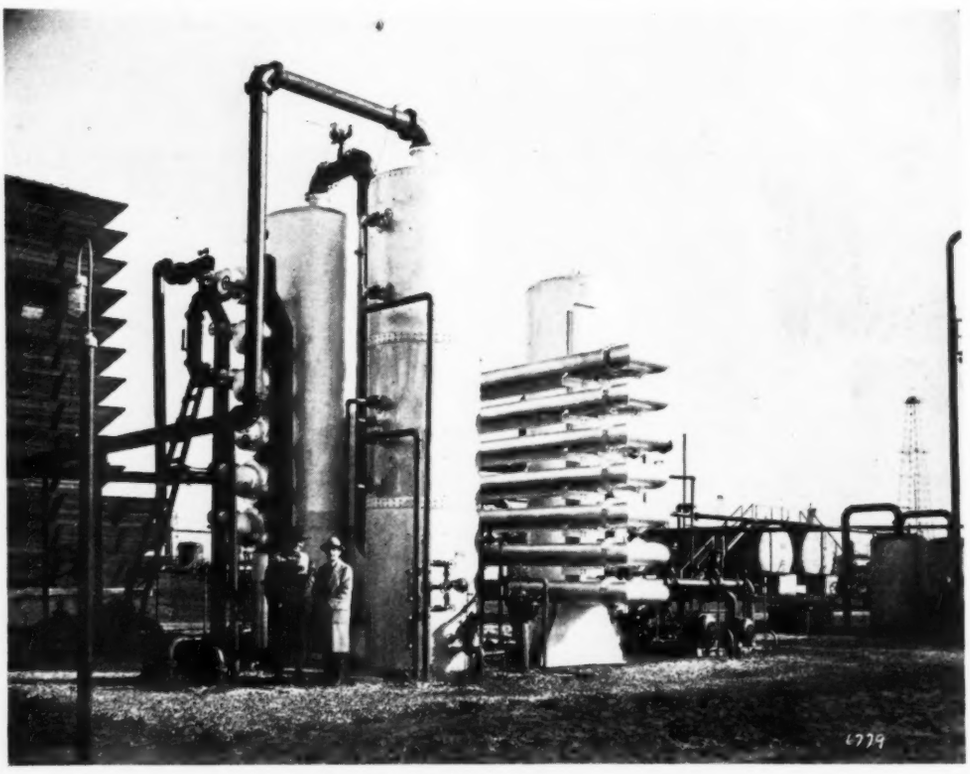
JUST as advertising played such a vital part in the expansion of the Eastman Kodak Co., so we believe it to be a most powerful force in the building of our many great American industries; in the wide diffusion and maintenance of our national prosperity.—George Eastman.

The most common ways of saponifying lime soap greases are by,

1) Steam cooking
2) Internal pressure
3) Direct fire

Practically all of the ordinary fats and saponifiable oils can be used in making these greases. The number of minerals oils that can be used is enormous. One can also use various proportions of caustic soda with the lime, as well as different quantities of water in the finished grease.

It has been deemed advisable in this article to avoid going into these variations and to discuss a simple method of making straight lime greases. This method is applicable regardless of the fats, saponifiable oils, or mineral oils that are used. By this method, one can obtain exactly the same results in a single barrel experimental kettle, as in a fifty-barrel kettle.



Topping plant of the I. T. I. O. Co. in the Oklahoma City field.

Equipment Required

A thirty-barrel steam-jacketed kettle is a suitable size for most purposes. This kettle is equipped with efficient stirrers driven by a 40 H.P. variable speed motor (chain drive preferably). This kettle should be jacketed at least three-fourths of the way up to prevent formation of hard lumps when the stiff grease is being thinned down. The boiler plant should be capable of maintaining eighty pounds steam pressure in the kettle.

A spraying device for the mineral oil should be at the top of the kettle. An ordinary spider made from one-inch pipe and perforated at the lower side answers quite well.

Raw Material Required

1) Medium colored tallow, having a titre of 40 degrees C to 41 degrees C and a Free Fatty Acid content of 8-12 per cent. This tallow should be clean and sweet smelling.

2) Mineral Oil

100 viscosity @ 100 degrees F. (Saybolt)
320 degrees F. Flash
370 degrees F. Fire
30 degrees F. Cold Test
Color: Light golden

3) Lime $Ca(OH)_2$
High grade material, very finely ground, and with very little $Mg(OH)_2$ present.

Formula

The following formula will make 10,000 pounds of a clear cup grease of medium consistency:

Tallow, 1800 pounds
Mineral oil,

on ANYBODY'S LINE!

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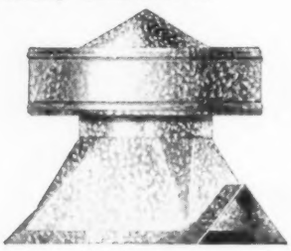

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SHEET BRASS, SHEET ZINC AND COPPER

7800 pounds
$Ca(OH)_2$, 290 pounds
Water, 110 pounds

Method of Manufacture

1) Charge 1800 pounds of tallow into kettle. Melt fat.
2) Add 1440 pounds mineral oil. Start agitation.
3) Sift 290 pounds of Ca $(OH)_2$ into mixture in kettle.
4) Add slowly 30 gallons water.
5) Give kettle sufficient heat to cause mixture to boil.

No more than 15 lbs. to 20 lbs. steam pressure should be used at this stage. This is sufficient to keep the mass boiling. If the steam pressure should accidentally get much higher and the mass of boiling soap should start to rise rapidly, one can easily control this condition by turning off the steam and sprinkling cold water on top of the soap. Under normal conditions, the soap gradually comes up in the kettle. After about two hours boiling the soap gradually starts to go down. At this stage the steam is slowly increased until the gauge registers 80 lbs. The pressure is kept at this point for one and a half hours. During all this time, the paddles are kept going. At the end of the one and a half hour cooking at 80 lbs. pressure, a sample is taken out by means of a long stick. The sample on cooling in a bucket of water should be clear and should crumble when pressed between the fingers. This condition shows that the soap is completely saponified. If the soap is not in this condition, a few gallons of water are cautiously added to the hot mass and after cooking for another half hour another sample is tested. As a rule, the sample, taken from the kettle at the end of the one and a half hour cooking at 80 lbs. pressure, will be transparent and will crumble when cooled and pressed between the fingers. As soon as this occurs, the steam is turned off, the stirring is stopped, and the sides of the kettle are thoroughly scraped down. Now start paddles with steam off, and

6) Add 360 pounds mineral oil.
7) Keep paddles going and allow mass to cool to 110 degrees C.
8) When temperature reaches 110 degrees C, increase speed of agitation and add rapidly 290 pounds warm water.
9) As soon as water is worked in, and before any of it is lost by evaporation, add rapidly about 500 lbs. of mineral oil.
10) If the 500 lbs. of mineral oil has cooled the mass, so that there is no sign of boiling, the stirring is continued for at least one-half hour longer, before adding more oil. If the 500 lbs. of oil has not cooled the mass sufficiently, add a few hundred more pounds of oil and stir until perfectly smooth.
11) From now on, samples are taken out before adding more oil to make certain that there are no lumps in the grease.

It should be borne in mind that a layer of stiff grease adheres to the sides of the kettle. To remove this layer and make the entire mass in the kettle homogeneous, all that is necessary is to turn the steam on rapidly for about a minute, or until one sees that this layer has been loosened and has started to work itself into the rest of the grease. It is important that the steam circulate all around the bottom of the kettle. For this reason one should make certain that the steam traps are not blocked.

After about 2000 lbs. of mineral oil has been added (in addition to the 2000 lbs. added at the beginning) the oil can be worked in more rapidly. Bear in mind at all times to

1) Keep sides of kettle clean.
2) Have grease perfectly smooth before adding more oil.

When a total of 7000 lbs. oil has been added, it is well to take out a pound can and allow it to cool. This cooled sample will be somewhat softer than the same grease when

run into a barrel. The grease will be too stiff at this stage for the ordinary medium cup grease. Half of the balance of oil, that is required by the formula, is now added and another sample taken out. If the grease is still a little too stiff, the balance of the oil is run in, the perfume added, and the grease is ready to run out after a final mixing. The temperature of the grease should now be about 165 degrees F.

It will be noted that small amounts of heat were applied to the grease as it was thinned down. As a result, the finished grease is now perfectly homogeneous throughout and it is safe to apply small amounts of heat when running the kettle out if the mass is cooling too rapidly, or if it is tending to stick to the sides of the kettle.

Before running this cup grease into barrels, about 25 pounds of the first grease that comes from the kettle should be run into the rework barrel. This grease will clean out the outlet pipe and there will be no danger of a customer complaining that he found some hard lumps.

Conclusion

In a brief article like this one, a number of points are necessarily omitted. It might be well, however, to state briefly how several other well known lime soaps are made.

1) By using a very heavy mineral oil throughout, and by using a greater percentage of this oil than was used in the above run, we would have obtained an excellent ball-bearing grease.
2) By using less of the 100 viscosity oil, but by adding extra water and soapstone, we would have obtained a Cold Neck Grease.
3) By using still less of the 100 viscosity and omitting the soapstone and extra water, we would have obtained a Hard Tallow Compound.

As stated in the first paragraph, the lime soap greases appear in an infinite variety of consistencies and colors. However, when one can make a good smooth cup grease as described above, all the variations become very simple to manufacture.

A. S. M. E. National Officers Visit Tulsa

THE American Society of Mechanical Engineers, through a dozen of its national officers, has under consideration ways and means by which that organization of nearly twenty thousand members will actively participate in the development of mechanical engineering as applied to oil field and refinery practice, with a view to effecting economies of operation and promoting safety of life and property. This group of national officers recently spent four days in making inspection trips and in conference with leading executives of the Petroleum Industry. Arriving in Tulsa, they were escorted by a group of executives and engineers headed by Thomas R. Weymouth, president of the Oklahoma Natural Gas Corporation; Arthur J. Kerr, chairman of the Mid-Continent Section, A. S. M. E., and William G. Heltzel, chairman of the National Petroleum Division of the A. S. M. E. They visited the Kelleyville Plant of the Oklahoma Natural Gas Corporation, where special arrangements had been made to have the plant in operation. Then after luncheon at the Harvey House at Sapulpa, the party drove to Hominy, where the pump station of the Sinclair Pipe Line Company was inspected.

The object of the visit was to give the national officers some conception of the amount of mechanical equipment used in the petroleum industry.

The officers of the Mid-Continent Section of the Society are Arthur J. Kerr, chairman, Pittsburgh Equitable Meter Company; William D. Moorer, vice-chairman, President Moorlane Company; Fred Thilenius, secretary, of the Prescott Pump Company; H. M. Manley, treasurer, of the Barnsdall Oil Company; Barton P. Sibole of the Sinclair Pipe Line Company, and P. M. Biddison.

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Jan. 20, 1925
No. 1523604

IN line with the Miller spirit of constant forward progress, we have simplified the name, identifying the Company with the Miller Sand Pump—the combination tool (can be used either as a bailer or sand pump) that has become famous throughout the oil fields of our own country as well as far distant foreign fields.

Manufactured to an engineering standard without equal. Constructed for high efficiency operation to give maximum results. Only in the Miller do you get the exclusive construction by which the wire line connects directly to the plunger, permitting use of a 25 or 30-foot tube, eliminating use of a rod—the sand pump that is the field man's choice. Constructed of National Seamless tubing and Sivyer Steel Castings. It is made to stand abuse. All steel throughout, eliminating use of leather washers.

Furnished with various type bottoms illustrated to meet any condition. Made in 2½, 3, 3½, 4, 4¼, 5, 5½, 7 and 9-inch diameters and 20, 25 and 30-foot lengths. Send for circulars and price list. The Miller Sand Pump is sold by leading supply stores everywhere.

Chancellor

Separator — another Miller product that is a positive gas anchor, cut oil preventor and acts as a double sand trap. This will raise the gravity a few points and thereby increase the price per barrel of your oil. Write for fully descriptive pamphlet.

Jiffy

pipe clamps are the quick, economical way to repair leaking spots in any type line at small cost. No bolts; all you need do is drive in the wedge to make an absolute tight joint.

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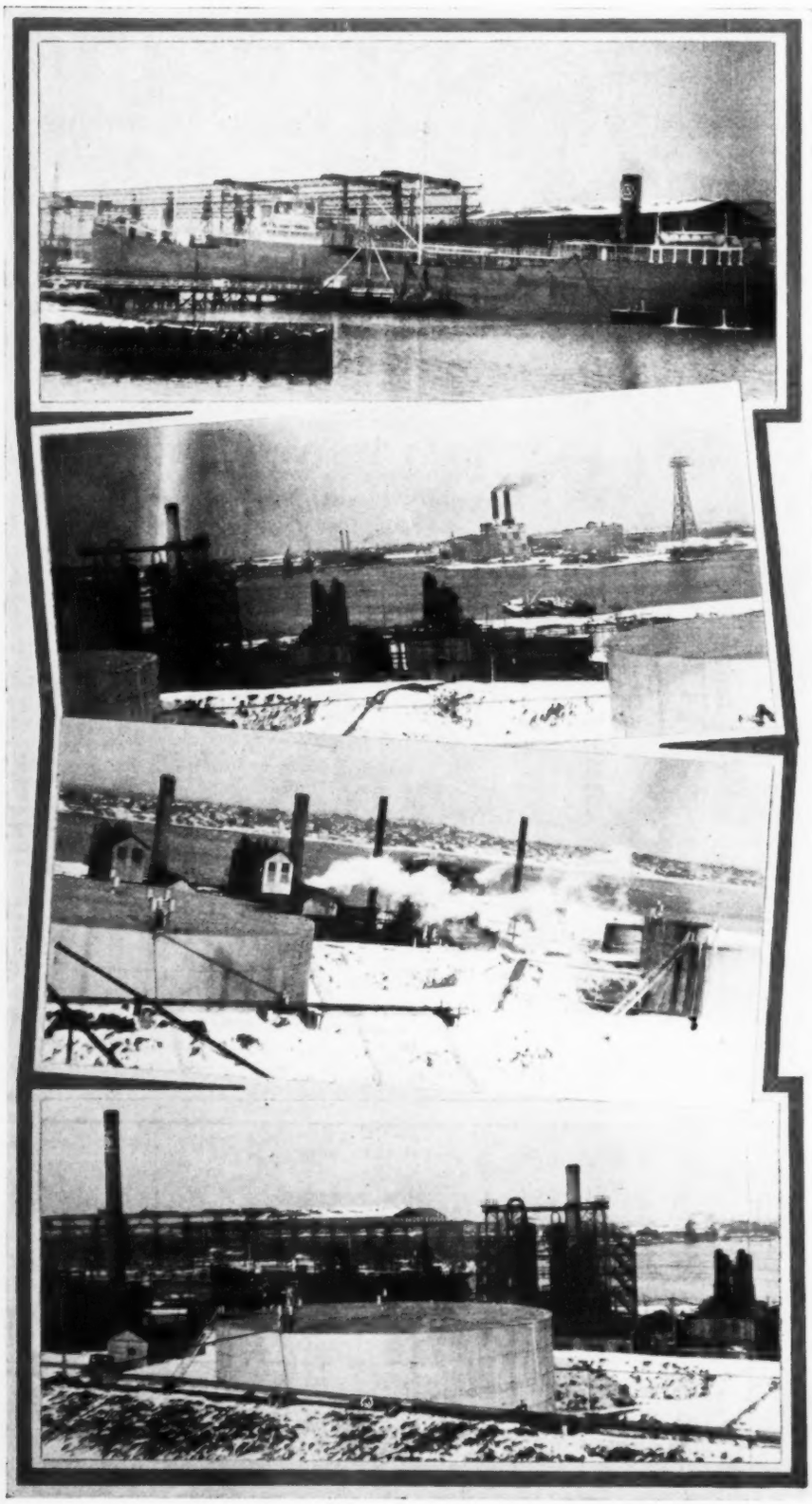
One of New England's Best Equipped Plants Is

Cities Service East Braintree Refinery



Several views of the East Braintree refinery, showing loading docks at top.

THE recent completion and placing in operation of the new distillation units and other new equipment make the Cities Service Refinery one of the largest and most modern in New England. The plant is located at East Braintree, on the waterfront near Boston. It is so located that crude oil can be brought up in tankers from Texas or South America and unloaded into the storage tanks at the refinery. A large part of the finished products is loaded into barges and distributed by water to the various New England cities and towns located on the bays or rivers. The refinery has a crude oil capacity between 15,000 and 20,000 barrels per day. At the present time it is operating on Refugio crude from Texas and also South American crude.

Facilities for unloading tankers in the shortest possible time are available. The Cities Service Co. maintains its own fleet of up-to-date tankers. One of the accompanying photographs shows the tanker "Hagood" unloading a cargo of 70,000 barrels of crude oil at the refinery. Gasoline and kerosene are loaded into barges at the wharf. On account of the location, advantage is taken to utilize to the fullest extent the cheap water transportation which is available.

Distillation Equipment

The old shell stills for distilling the crude oil have been replaced by the most modern and efficient type of equipment. The refinery operates two distillation units. These are pipe stills equipped with fractionating towers and heat exchangers. One unit has a rated capacity of 10,000 barrels of crude oil per day, and the second one, 5,000 barrels per day. These stills are shown in the photographs accompanying this article.

They are steam-atmospheric units, taking gasoline, naphtha, kerosene, gas oil, and wax distillate overhead. A complete instrument installation and control equipment are used on each unit to maintain the most satisfactory results at all times. The towers and lines are so arranged on the units that flexibility is available when the crude is changed.

Cracking Units

Two types of cracking units are operated which take care of either reduced crude or gas oil as charging stock. The cracking equipment consists of two Holmes-Manley stills and two Doherty stills. The latter operate at very high thermal efficiency due to their economizers for preheating the air for combustion by the flue gases. In the operation of the cracking units every precaution is taken to maintain the safest condition at all times. As on the crude stills, the cracking units are operated with a complete instrument installation so that conditions in all important parts of the unit can be controlled and recorded.

Treating

The pressure gasoline is treated in a continuous treating plant. The standard method is used with sulphuric acid, caustic soda, and sodium plumbite.

Lubricating Oil

A wax distillate is made from the crude oil which is further refined into light lubricating oil. The wax distillate is dewaxed by the standard wax plant procedure. The distillate is chilled, pressed, and acid treated, and neutralized. The treated oil is then filtered through fuller's earth. The pressed wax is sweated to remove the foots oil and raise the melting point, and treated and filtered before shipping as refined white wax. A complete wax plant is maintained to produce and prepare finished wax for the market.

A very large filter house is operated at the refinery. This is equipped with conveying machinery to handle the clay and large multiple hearth furnace for reburning the filter clay. All of the neutral oils produced from the wax distillate are filtered in this plant through percolating filters, producing a very beautiful high quality pale neutral oil. Various viscosity oils can be made.

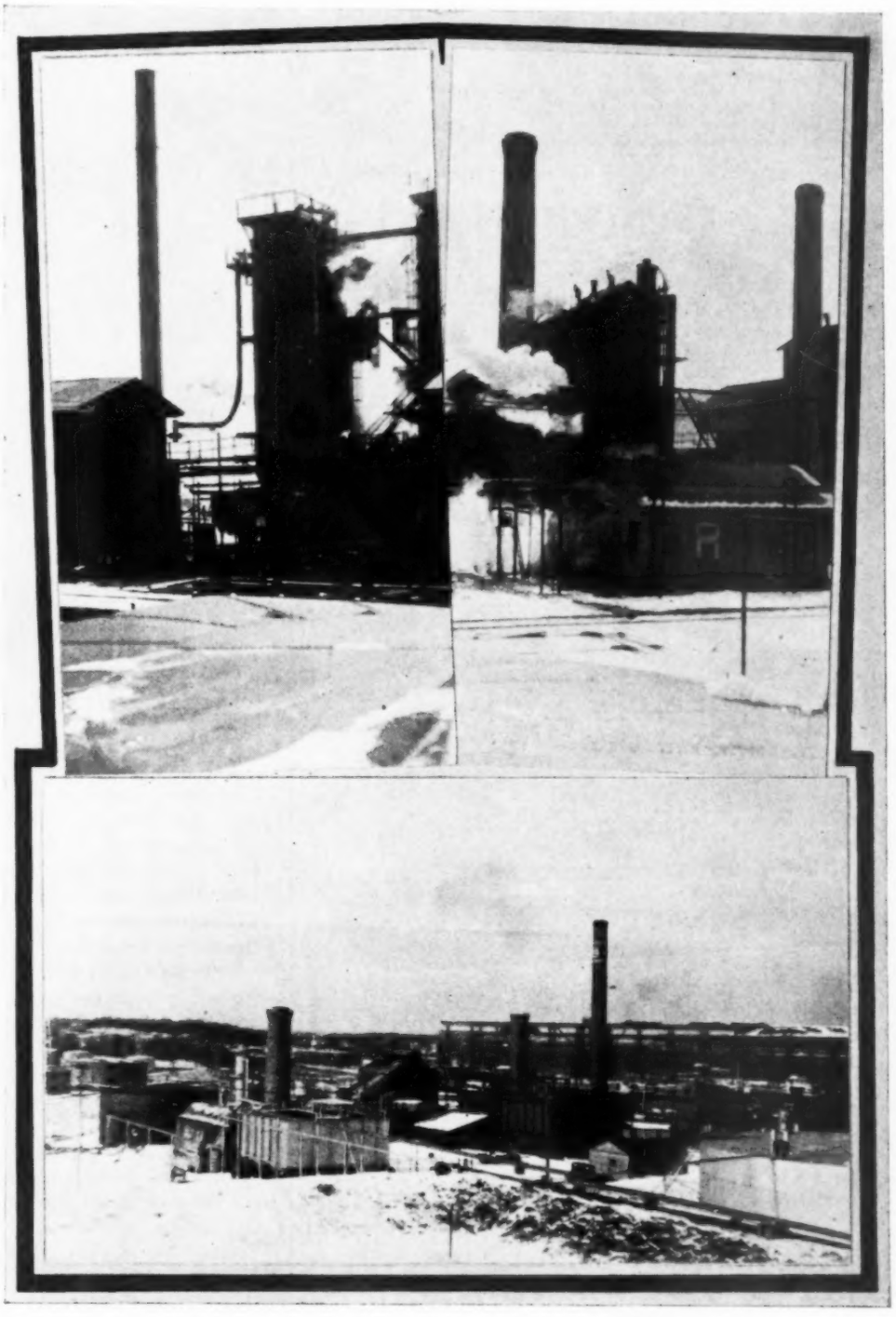
Boiler House and Shops

As in most Cities Service refineries, a modern boiler house of adequate capacity is operated in this plant. An engineering staff is maintained at the refinery and is capable of handling or supervising all construction and maintenance work. During the past two years, the refinery has been almost entirely rebuilt, and much of the old equipment had to be torn down to make way for the new. Consequently the engineering department has been kept very busy. H. A. Mott is chief engineer at the refinery.

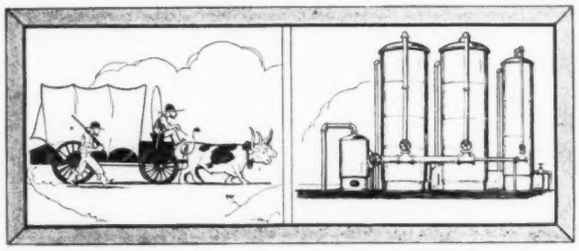
Very large, well-equipped shops are maintained to handle much of the mechanical repair and maintenance work in the refinery. The shops include a machine shop, a welding department, and a blacksmith shop.

Research Laboratories

Very complete chemical and physical laboratories for control and research work are located in the refinery. W. E. Shuman is chief chemist and also director of research and development. He is assisted by a staff of chemists. All refining processes are controlled by the laboratory where work on both gasoline and lubricating oils is carried on. Much research work is being done on waxes and various methods of dewaxing oils.



Above, the cracking units at East Braintree. Below, a view of the boiler house.



Pioneers Both

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"Oil-Froth" absorbers hold original patents on the following characterizing features:

1. Plates packed off against the side of the shell
2. Double-shell assembly
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Any other absorber embodying the above is an infringement, and will be handled as such just as soon as the developers of "Oil-Froth" absorbers can take a day off from the task now engag.ng them—introducing new and original equipment to the industry.

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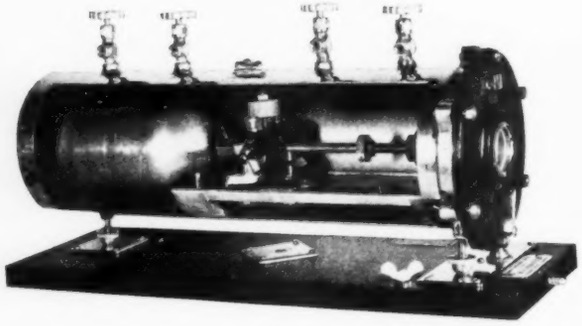

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Fast Time Made Landing and Cementing Long String of Nine-Inch Casing

IT would seem that any operator looking for interesting information relative to modern oil well efficiency in either drilling, running long strings of casing, cementing, putting out fires, or any other problem, would do well to get the latest news from the front in Santa Fe Springs. There they have acquired a special ability to do tough jobs in jig time, and do them well. The latest accomplishment was consummated the other day on Richfield's Howard No. 5. While no striking records were made, the speed and smoothness of the entire operation were very noticeable.

After cementing off the original casing, 18⅝-inch, the hole was put down to 4200 feet, using 13⅜-inch casing. This string was cemented and drilling continued. Water was encountered again between 6300 and 6400 feet, necessitating another shutoff. Preparations for running the next string of casing were, without doubt, partly responsible for the smoothness of the entire operation, and, as they may differ somewhat from the general practice of many operators, they are given here in detail.

During drilling operations a little oil was used to grease the hole at all times, to facilitate the running in and pulling of the drill string, as well as to make it less likely that a "fish" would stick. The hole was drilled 12¼-inch, the only reaming done being that by the rock bit. Before running in the next string of casing, which was 9-inch, the mud was thinned out considerably, and 65 barrels of oil added as additional "grease." It required only 17½ hours to run in the entire string of 6399 feet of 9-inch and, while this time may not be a record, the entire absence of trouble during the operation is noteworthy. A special high side-hole cement float shoe, 40 inches long and the side holes placed 28 inches above the bottom, was used in conjunction with a cement float collar, which was placed one joint above—approximately 40 feet.

There is a difference of opinion as to the value of maintaining an unbroken circulation during the lowering of long strings of casing, as in this instance. Be that as it may, Ira Brown, drilling superintendent of the Richfield Oil Company, who handled this operation, maintains that a thinned mud and the proper floating of the string is preferable. The entire absence of any trouble during this operation would seem to bear out his contention. Unless the mud is thinned out to the proper consistency, it is practically impossible to lower a long string without breaking circulation, which immediately eliminates the floating principle and throws the entire weight of the string on the rig and equipment. If the proper precautions are taken, however, there should be no necessity for breaking circulation until the string is resting safely on bottom. This permits maintaining the floating principle as well as staying within the safety factor of the tensile strength of the casing. In the present case, when the string was landed, the top 1360 feet was floating—empty of fluid. After landing the string a sufficient strain was taken to straighten the string and circulation was broken as soon as the pumps were started, using less than 100 pounds pressure. The mud was then further thinned out, until it was only a little thicker than water, in preparation for the cementing job.

The entire cementing job took only 45 minutes, of which 32 minutes were consumed in pumping the plug down to the cement float collar, which acted as a stop or baffle plate. As further evidence of the smoothness with which the cement was placed, the cement flowed out of the high side hole cement shoe so fast that it took the plug 20 minutes to catch up with it, the pumps running full draft. The stoppage of the plug at the cement float collar left approximately

40 feet of cement inside the casing. Ira Brown, the drilling superintendent, gives much credit to the high side hole cement float shoe and the cement float collar for the speed with which the entire operation was completed, as well as the fast job done in cementing. The four side holes in the float shoe not only make for fast running of the cement, but also secure a proper distribution of the cement on all sides of the casing.

NOTE: The high side hole cement float shoe used is similar to a side hole shoe, excepting that it is 20 inches longer placing the side holes farther from the bottom of the shoe It is used only for extremely deep wells.

International Expo Space Sells Fast

CONTRACTS for exhibit space at the 1930 International Petroleum Exposition and Congress, October 4-11, have been available for little more than a week, and already seventy-five per cent of the exhibitors in the 1929 oil show have announced their intention of exhibiting this year, according to Wm. B. Way, general manager.

An intensive program for bringing the Exposition to the attention of oil executives all over the world was started last week and more than 15,000 rotogravure folders giving information about the oil show have been sent to oil men in the United States, Mexico and Canada. The Petroleum Engineer Publishing Company provided the folders.

In foreign countries contracts have been made with more than 1500 men directly interested in petroleum so that a larger representation from abroad is expected than in previous years.

Death of Mrs. Chas. N. Hough

MRS. KATHRIN HAGENBUCH HOUGH, aged 61, widow of Charles N. Hough, died recently at her residence at Franklin, Pa., after an eight-months illness.

Mrs. Hough was born in Williamsport on October 17, 1868. On June 18, 1900, she was married to Mr. Hough. In the fall of 1901 Mr. Hough moved to Franklin to found the Hough Manufacturing Company's plant and his wife joined him at the beginning of the following year.

Mrs. Hough was a member of St. John's Church and allied organizations. She took particular interest in the Needlework Guild of America and the Venango chapter of the D. A. R. In the latter organization she was regent for several years.

Surviving are her son, Charles N. Hough, of Franklin; her daughter, Miss Katherine Hough, and a sister, Miss Clotilda Hagenbuch, at home, and another sister, Miss Caroline Hagenbuch, in East Orange, N. J.

Casing Job at Kettleman Hills

A STRING of 9-inch OD 45-pound casing was landed and cemented at 7275 feet in a Kettleman Hills well by the Bolsa Chica Oil Company. The mud was completely changed and also thinned out somewhat before the casing was run in the hole. Al Freer, superintendent of the Bolsa Chica, says that new mud can be thinned out and still have as much weight as old mud that is much thicker but has been cut with sand and gas. A cement float shoe and cement float collar were run on the bottom joint and from 5000 feet on no fluid was pumped into the casing until it was landed on the companion flange. Therefore, 2275 feet of casing was floated in. To date the limit that other operators have been able to put successfully behind the casing is 400 sacks of cement. Al Freer, knowing that the hole was in exceptionally good condition, decided to try 650 sacks of cement. He broke circulation with less than 250 pounds pressure and bumped the plugs with 750 pounds of pressure. The casing was not set on bottom, but was suspended about 20 feet off bottom.

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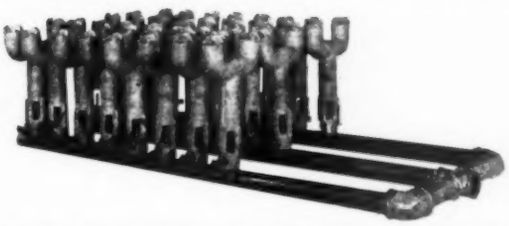

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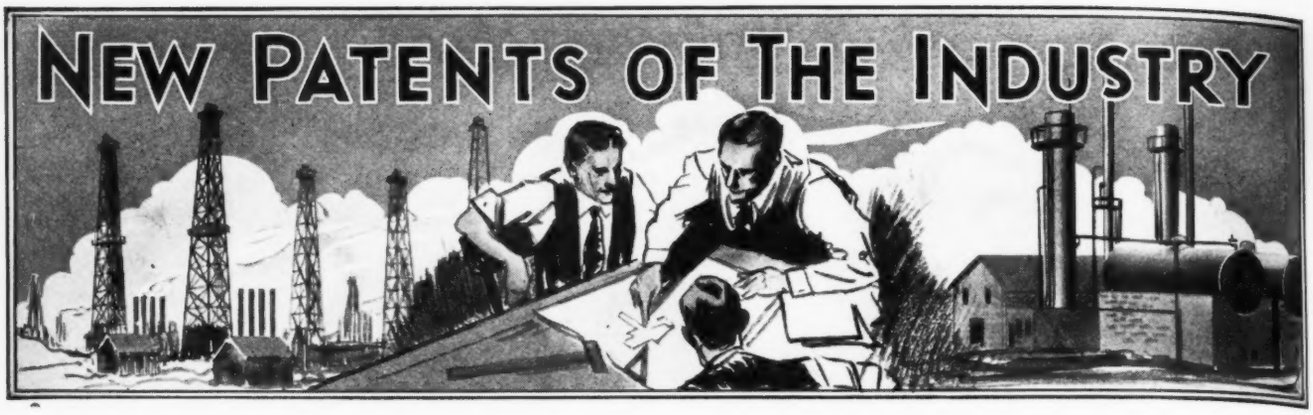
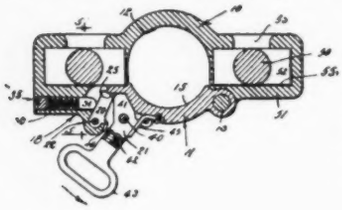


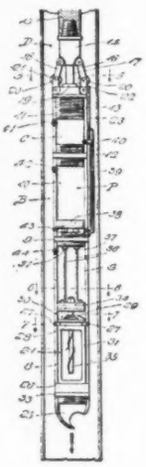
1,738,820. ELEVATOR. DENNIS L. DRISCOLL, Alhambra, Calif. Filed Mar. 28, 1925. Serial No. 19,026. 2 Claims. (Cl. 224—90.)

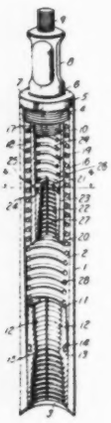


1. A support for an elevator including, a vertical rod having a transverse T head formed on its lower end, a projection on the elevator having an opening to pass the rod, a socket to hold the head and a passage to admit the head into the socket, and means for closing the passage.

1,747,398. WELL CLEANER. POSEY R. SHORT, Tulsa, Okla. Filed Apr. 19, 1928. Serial No. 271,292. 12 Claims. (Cl. 166—20.)

5. In a well cleaner, a tubular body opens at its lower end, a tubular agitator rotatably mounted in said lower end of said body, said agitator having an opening in its upper end and an upwardly opening check valve at its lower end, vertically movable means for rotating said agitator and means for creating upward suction therein said suction means being mounted in said tubular body.

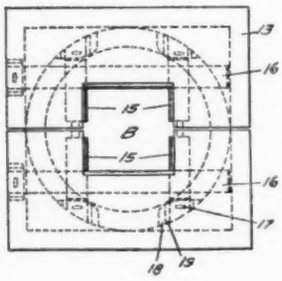




1,734,338. SLIP SOCKET. ALBERT H. NEILSON, Tulsa, Okla. Filed Mar. 19, 1928. Serial No. 262,934. 6 Claims. (Cl. 294—102.)

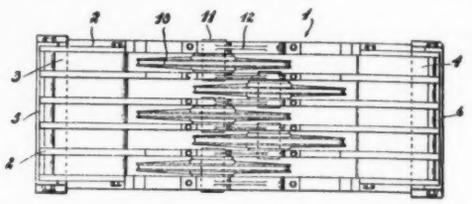
1. A socket comprising a barrel, a set of slips mounted in the barrel.

1,749,809. DRIVE BUSHING FOR ROTARY DRILLING MACHINES. EDGAR E. GREVE, Bellevue, Pa. Filed Dec. 24, 1925. Serial No. 77,672. 4 Claims. (Cl. 308—6.)



4. A drive bushing for rotary well drilling machines having a central stem receiving opening and a plurality of roller receiving openings, two roller drive stem contacting members carried thereby in said roller receiving openings, and each having a portion thereof projected into the stem receiving opening, one member arranged at right angles with the other member, and means for securing the contacting members in the roller receiving openings of the bushing including a detachable pin entered in a pocket of the bushing.

1,749,906. CROWN BLOCK. GUSTAVE J. CORMIER, Seminole, Okla. Filed June 28, 1928. Serial No. 289,013. 3 Claims. (Cl. 254—190.)

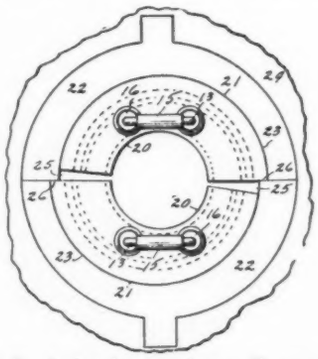


1. A crown block comprising a plurality of beam plates, spacing blocks positioned between adjacent plates, bolts extending through the plates and spacing blocks, sheaves mounted between adjacent pairs of plates, a pin upon which each sheave is journaled, and clamps extending over the pins and secured to the top of the beam plates, and angle plates positioned at both ends of the beam plates in which said beam plates are adapted to rest, and bolts extending through the beam plates and angle plates.

1,733,837. COMBINATION BAILER, DUMP, AND PUMP. HARRY J. STEINBERGER and HARRY A. MILLER, Clovis, N. Mex. Filed Aug. 31, 1927. Serial No. 216,714. 3 Claims. (Cl. 166—19.)

1. In a device of the class described, a tube, a dart controlling the lower end of the tube, a jarring element associated with the tube for relative up and down movement, and a flexible element detachably connected with the lower end of the jarring element and swivelly connected with the upper end of the dart.

1,749,946. WEDGE SLIP FOR ROTARIES. JOSEPH W. KAOUGH, near Houston, Tex. Filed June 7, 1928. Serial No. 283,591. 8 Claims. (Cl. 24—263.)



1. In a wedge slip device for rotaries, a slip member having a gripping face concentric to the axis of the slip and an outer wedge face formed eccentric to said gripping face, an enclosing member having an eccentric face corresponding to the eccentric face upon the slip and means for imparting rotary movement to said member to shift the same upon the outer slip face.

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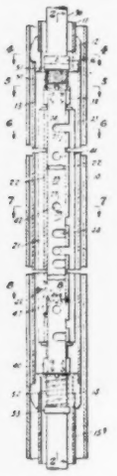
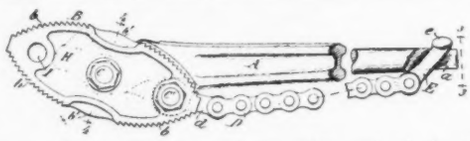
1,750,146. FLUID-OPERATED PUMP. James A. Wray, Los Angeles, Calif. Filed Dec. 28, 1926. Serial No. 157,456. 10 Claims. (Cl. 121—129.)



1. In combination with a well casing, a fluid motor for a pump comprising a shell mounted within said casing and spaced therefrom to form an annular motive fluid inlet space, a motor cylinder disposed within said shell and spaced therefrom to form therewith an annular motive fluid exhaust space, there being intake ports in said shell and said cylinder disposed in registration, there being exhaust ports in said cylinder, valves slidably mounted in said exhaust space for controlling said intake ports, said valves having intake ports for registration with the intake ports in said shell and cylinder and exhaust ports in said valve having peripheral communication with said exhaust space, a reciprocable operating rod within said cylinder, motor pistons secured to said operating rod for reciprocation in said cylinder, said valves being slidably mounted on said operating rod, and tappet means on said rod to engage and move said valves.

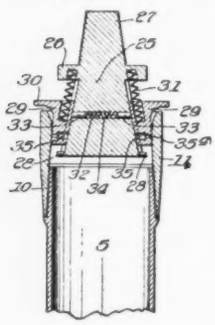
1,750,043. CHAIN PIPE WRENCH. Willard C. Kress, Buffalo, N. Y., assignor to J. H. Williams & Co., Buffalo, N. Y., a corporation of New York. Filed Apr. 28, 1928. Serial No. 273,690. 9 Claims. (Cl. 81—66.)

1. A pipe wrench comprising a handle having a slot in one end and a flat link chain, one end of which is anchored near the end of the handle



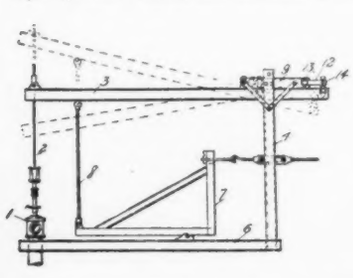
other than that having the slot and the other end of the chain being engageable when not in use in said slot in the handle, the slot in the handle and the faces of the chain links lying in parallel planes.

1,749,827. LETTING-IN TOOL. Patrick H. Mack, Bradford, Pa., assignor to Oil Well Supply Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed Aug. 1, 1923. Serial No. 655,017. 5 Claims. (Cl. 294—96.)



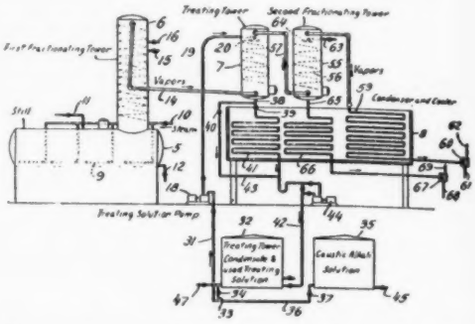
1. A letting-in tool for lowering devices into earth borings, comprising a body having an upwardly tapered lower portion, means at the upper end of the body for attachment to a suspending means, slips slidably carried on the tapered lower portion of the body, means normally tending to move the slips into operative positions, said slips being expanded by a downward movement relatively to the body and being contracted by an upward movement relatively to the body, and lateral stop projections on the slips.

1,750,021. OIL-WELL PUMPING JACK. Rupert Bernard Norris, Tulsa, Okla., assignor to W. C. Norris, Tulsa County, Okla. Filed Apr. 5, 1929. Serial No. 352,835. 2 Claims. (Cl. 74—5.)

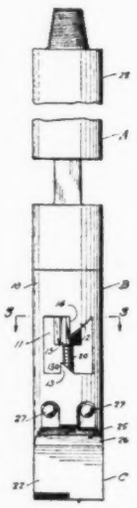


1. A pumping jack for pumping an oil well, comprising a pumping beam mounted on a stationary standard, means of oscillating said beam and means of connecting a polished rod to said pumping beam at its weight bearing point; a stationary cam track on said stationary standard with the cam track longitudinally disposed with said pumping beam; a link pivotally connected to said stationary standard, and with said link also pivotally connected to said pumping beam, said link being of a predetermined length and having its axis at a predetermined point with reference to the fulcrum point of said pumping beam to correlate the arc prescribed by the point of its connection on the said pumping beam with the predetermined arc prescribed by the weight bearing point of said pumping beam to cause the last named point to travel in a substantially straight line when said pumping beam is oscillated; a roller cam attached to said pumping beam at a point thereon between said link connection thereto and the weight bearing point thereof, and with said roller cam engaging said cam track and free to move thereon and constituting the fulcrum of said pumping beam; and means of retaining said roller cam on said cam track.

1,749,896. MANUFACTURE OF LUBRICATING OIL. George H. Taber, Jr., Rye, N. Y., assignor to Sinclair Refining Company, New York, N. Y., a Corporation of Maine. Original application filed Jan. 14, 1925. Serial No. 2,262. Divided and this application filed May 26, 1928. Serial No. 280,790. 2 Claims. (Cl. 196—36.)



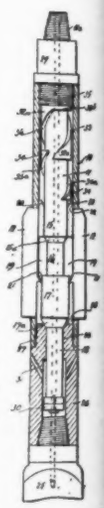
1. In the manufacture of lubricating oils the improvement which comprises continuously vaporizing lubricating oil constituents from a stock containing the same, continuously taking off the lubricating oil vapors and subjecting them as such to treatment with a caustic alkali solution, maintaining the temperature in this treatment to condense a minimum of lubricating oil constituents, continuously taking off lubricating oil vapors from this treatment free from alkali, and condensing a lubricating oil fraction from the vapors taken off from the alkali treatment, whereby said condensed lubricating oil fraction is subjected to the alkali treatment in the vapor phase but condensed out of contact with the alkali.



1,743,765. COMPOSITION CONSTRUCTIONAL UNIT. Albert C. Fischer, Chicago, Ill., assignor to The Philip Carey Manufacturing Company, a Corporation of Ohio. Filed May 5, 1926. Serial No. 106,984. 6 Claims. (Cl. 94—18.)

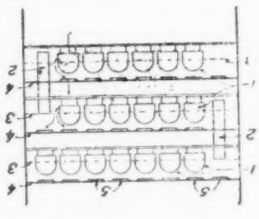
1. A preformed compressible and expansible constructional unit comprising a normally plastic strip of ductile waterproofing material having relatively long animal hairs incorporated and distributed therein to give an elastic character to the strip, and the proportion of waterproofing material preponderating.

1,743,528. UNDERREAMER. Lawrence Campbell, Kansas City, Mo., assignor to John Grant, Los Angeles, Calif. Filed Apr. 9, 1927. Serial No. 182,520. 7 Claims. (Cl. 255—75.)



1. A rotary cutting tool, embodying two members movable vertically and rotatively relative to each other, a radially movable cutter mounted in one member, the cutter and the other member having interengaging formations that cause outward movement of the cutter by virtue of relative upward movement of the cutter-carrying member and its cutter helical means actuated by virtue of relative rotation between the members to move the cutter-carrying member upwardly with relation to the other member, the pitch angle of said helical means is such that the cutter-carrying member being free to move downwardly under its own weight unrestrained by said helical means.

1,743,131. BUBBLE-TOWER BAFFLE PLATE. Victor F. Grace, Los Angeles, Calif. Filed Oct. 3, 1927. Serial No. 223,662. 2 Claims. (Cl. 261—114.)



1. In a bubble-tower dephlegmator; a splash plate interposed between a pair of bubble plates, vapor rises on said plates each surmounted by a bubble cap, said splash plate having a perforation located substantially over each bubble cap in the bubble plate next below and being otherwise substantially vapor tight.